VAPOR BARRIERS

IN FOUNDATION REPAIR

From Polymer Science to Field Application

NFRA 35th Annual Convention · **50-Minute Certification Session**

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Enrique Aranda Sales Manager, The Liner Guys

ABOUT THE PRESENTERS

Who We Are

Fabian Abramovici

CEO & Co-founder, The Liner Guys

- 20+ years directing manufacturing: extrusion & injection molding (PVC, Nylon, PP, PE)
- Founded The Liner Guys in 2018
- US-based manufacturer — Cross-Woven PE Vapor Barriers
- Expertise in Manufacturing

Enrique Aranda

Sales Manager, The Liner Guys

- Field-facing experience across contractor and distributor channels
- Deep knowledge of product selection and application contexts
- Florida Based - Working the market daily

SESSION OVERVIEW

What We'll Cover Today

50 minutes · 7 sections

01
Plastics & Polymers
Origin, types, why PE works

04
Materials & Performance
Mil, density, fillers — the real story

02
Manufacturing Processes
Extrusion, co-ex, weaving, lamination

05
Product Selection
Matching the right barrier to the job

03
Vapor Barrier Landscape
Categories, standards, perm ratings

06
Why Materials Matter
What the science explains

07 Q&A & Key Takeaways

Polymers are large molecules built from repeating chemical units — long chains derived from petrochemical processes. Their molecular structure determines everything: strength, flexibility, thermal behavior, and whether water can pass through them. Every synthetic plastic you've ever worked with is a polymer. The question is always which one, and how it was engineered.

A Brief History of Synthetic Polymers

From accident to global industry

1907 — Bakelite — first fully synthetic plastic (Leo Baekeland). Rigid, heat-resistant, non-conductive.

1933 — Polyethylene discovered accidentally at ICI, UK during high-pressure chemistry experiments.

1950s–60s — Post-WWII petrochemical boom: PP, PVC, Nylon, polyesters enter mass production.

Today — 400M+ metric tons produced annually. Construction is one of the largest end-use sectors.

Why Plastics Changed Construction

Problems that wood, concrete, and metal couldn't solve alone

Moisture impermeability

Polyethylene is non-polar. Water molecules have no chemical affinity for it — they cannot penetrate a well-formed PE film. This is the fundamental property behind every vapor barrier.

Weight-to-strength ratio

A 20-mil woven laminate weighs less than 1 lb/sf yet resists hundreds of pounds of puncture and tear force. No traditional material achieves this combination.

Chemical inertness

PE does not rust, rot, or react with normal soil chemistry. A vapor barrier in contact with moist soil for 20 years is essentially unchanged — if it's the right formulation.

Formability

Polymers can be extruded, woven, laminated, and engineered to specific performance targets. This is why the product spectrum runs from 4-mil basic poly to 20-mil cross-woven laminates.

Polymer Families Relevant to Vapor Barriers

Not all polyethylene is the same

HDPE

High-Density Polyethylene

Tightly packed linear chains · High tensile strength · Low permeability · Used in woven scrim layer of premium barriers

LDPE

Low-Density Polyethylene

Branched chains · Softer, more flexible · Higher permeability · Used in film layers

LLDPE

Linear Low-Density PE

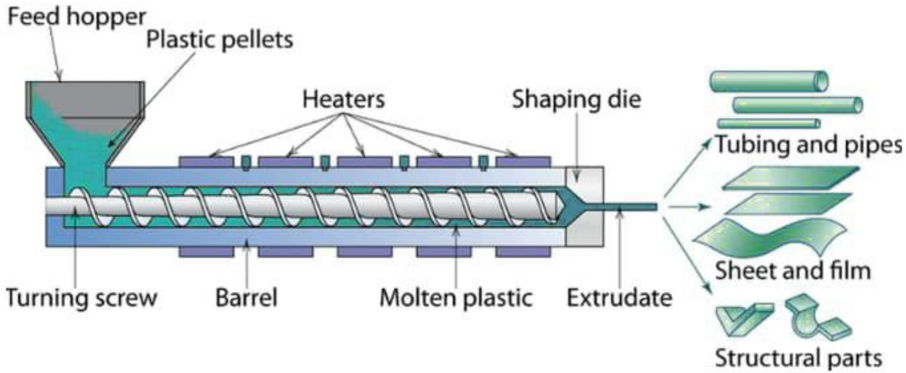
Intermediate structure · Better puncture resistance than LDPE · Used in higher-grade films

PVC: historically used in barrier products — heavier, less flexible at low temps, less chemically inert than PE. Largely displaced by PE in modern vapor barriers.

Extrusion: Where the Film Begins

The core process behind every PE vapor barrier film

- Resin pellets fed into a heated barrel — rotating screw melts and homogenizes the polymer
- Molten PE forced through a die: circular die (blown film) or flat slot die (cast film)
- Blown film: air inflates a bubble → biaxial orientation → improved strength in both MD and TD directions
- Cast film: higher thickness uniformity, but lower MD/TD strength balance than blown film
- Line speed, temperature profile, die gap, and cooling rate directly control thickness and mechanical properties
- Variability in any parameter = inconsistency in the final product



Co-Extrusion: Layering Performance

Combining polymers in a single pass

What it is: Multiple polymer layers fused through a multi-manifold die in a single pass — bonded at the molecular level, no adhesive required.

Outer layer	LDPE — UV resistance, surface protection, tape adhesion surface
Core layer	LDPE/LLDPE — flexibility, elongation, impact resistance
Inner layer	LDPE — moisture barrier function, contact surface

Important: Co-extruded films improve on basic poly — but without a woven scrim, performance still relies on film elongation under load. The step from co-extruded to cross-woven is not incremental — it is architectural.

The Cross-Woven Architecture

Three steps that produce a fundamentally different product

01 Tape Extrusion

HDPE resin extruded into flat monofilament tapes

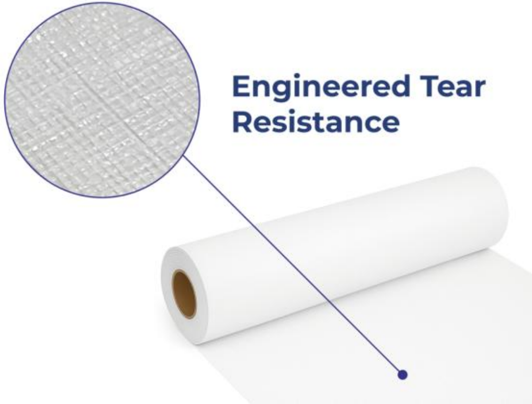
02 Weaving

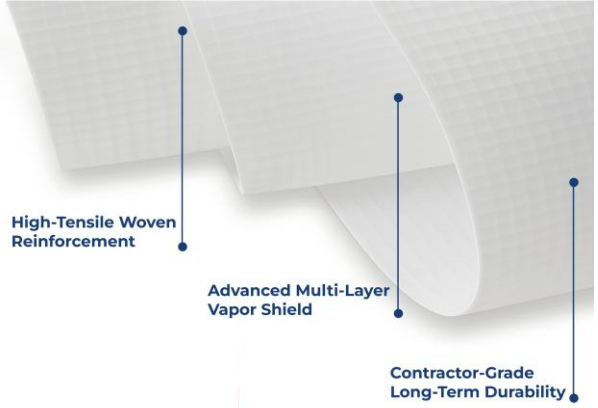
Tapes woven at 90° — warp and weft cross-woven construction

03 Extrusion Coating

Molten PE extruded onto both scrim faces — molecular bond, no adhesive

Result: A three-ply laminate — load distributed across the weave geometry, not concentrated at a single point. Like a net absorbing impact vs. a film absorbing it alone.





Virgin Resin vs. Recycled/Regrind

Why what's in the recipe matters as much as the process

Virgin Resin

- Consistent melt index, density, and additive profile across every production batch
- Predictable surface chemistry — tape adhesion behaves the same from roll to roll
- Full molecular chain integrity — no contamination from mixed polymer streams
- ASTM E1745 certification of a virgin-resin product reflects actual, consistent production quality

Recycled / Regrind Resin

- Mixed polymer streams — variable melt index, density, and contamination levels
- Surface energy variation batch to batch — same tape may not adhere consistently
- Can achieve ASTM E1745 certification on a tested sample that doesn't represent ongoing production
- Micro-void propagation risk: inconsistent filler/contaminant particles create long-term failure points

The professional question to ask: 'Is this product made from virgin resin, and do you certify that consistently?' The answer tells you a lot.

Not All Vapor Barriers Are the Same

Five product categories — five different performance profiles

Basic Poly Sheeting	*Temporary / under-slab low-demand*
Co-Extruded Multi-Layer Film	*Standard residential encapsulation*
Cross-Woven PE Laminate	*Full encapsulation / permanent / radon*
Radiant Barrier	*Hot climates — thermal + moisture*
Drainage Composite	*Active seepage / wet basements*

Vapor Barrier vs. Vapor Retarder

Permeance classes and what they mean in the field

Common confusion: 'Vapor barrier' and 'vapor retarder' are not the same thing. The classification is based on measured permeance — not on product labeling.

CLASS I

< 0.1 perms

True Vapor Barrier

Cross-woven PE laminate

CLASS II

0.1–1.0 perms

Vapor Retarder

Some co-extruded films, kraft-faced insulation

CLASS III

1.0–10 perms

Vapor Retarder

Latex paint, unfaced fiberglass insulation

For crawl space encapsulation and foundation repair: Class I (< 0.1 perms) is the target. The best cross-woven products test at 0.019 perms.

The Standards That Matter

ASTM E1745 · E96 · E84 · IRC R408 · EPA 402

IRC R408

- Residential code minimum for crawl spaces. Code compliance is the floor — professional specification exceeds it.

- The governing standard. Classes A, B, C by tensile, puncture, and permeance. Class A = highest — required or recommended for crawl space and foundation applications.

ASTM E96

- Measures water vapor permeance in perms. Procedure B (wet cup) is the demanding test. Class I < 0.1 perms.

EPA 402

- Radon mitigation standard. Governs sub-membrane depressurization systems — the vapor barrier is the primary membrane.

ASTM E84

- Surface burning characteristics. Class A (flame spread 0–25, smoke 0–450) required for permanently exposed products in enclosed spaces.

20 Mil ≠ 20 Mil

The most misunderstood spec in the market

Common misconception: '20 mil is always better than 12 mil.' Mil is a thickness measurement only — it tells you nothing about resin type, filler content, strength, or perm rating.

What MIL tells you

- Nominal thickness (1 mil = 0.001")
- Baseline geometry of the product only

What MIL does NOT tell you

- Resin type or purity
- Filler content
- Tensile or puncture resistance
- Water vapor permeance (perm rating)
- Actual material mass per unit area

→ Always ask for weight per MSF (lbs/thousand sq ft) alongside mil thickness. That is the real comparison.

The Weight Test: More Material = Better Barrier

Measuring actual polyethylene content

- Pure HDPE density ≈ 0.95 g/cm³ — a 20-mil virgin-resin product has a predictable, calculable weight
- Cross-woven 20-mil laminate from virgin resin: ~62 lbs/MSF (14 oz/yd²)
- Competitor '20-mil' product at 41 lbs/MSF = ~21 lbs less polyethylene per thousand sq ft
- That missing mass is either air, or filler — neither adds barrier performance

Field test: Cut a 1-foot square from two products. Weigh them. The heavier product contains more actual polyethylene. More material = more barrier. This is a legitimate specification tool.

The Filler Problem

How manufacturers inflate thickness — and what it costs

Calcium Carbonate ($CaCO_3$)
Most common. Can be 20–40% of a low-grade film. Cheap and readily available.

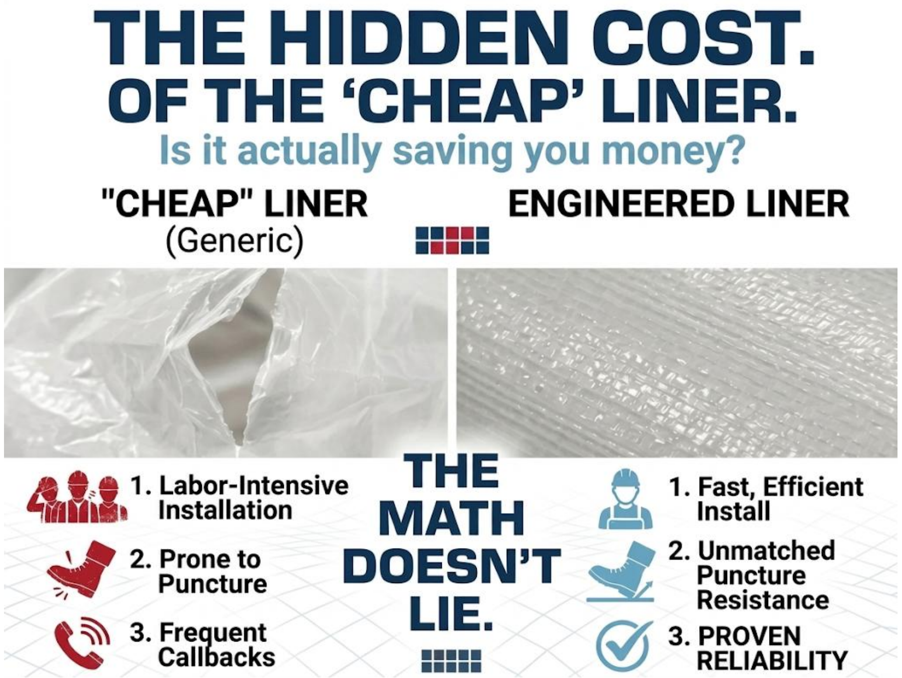
Talc
Used for stiffness and processing. Similar negative performance impact.

Titanium Dioxide (TiO_2)
Used for whiteness. Less problematic in small amounts.

Tensile strength	✖	Filler disrupts polymer chain continuity — matrix weakened
Puncture resistance	✖	Brittle filler particles create stress concentration points
Elongation at break	✖	Severely reduced — film cracks earlier under thermal cycling
Water vapor permeance	✖	**Can INCREASE — micro-voids at filler-polymer interface allow vapor through**

Side by Side: Virgin Resin vs. Filler-Heavy

Property	Virgin Resin	Filler-Heavy
Tensile strength	Full polymer engagement	Matrix disrupted by filler
Puncture resistance	Scrim distributes load	Filler initiates cracks
Elongation	500–760% (film break)	Severely reduced
Vapor permeance	Consistent < 0.1 perms	Variable — can exceed spec
Weight at 20-mil	~62 lbs/MSF	~41 lbs/MSF or less
Long-term durability	Stable — PE chemically inert	Micro-void propagation risk



Product Types In Detail

Basic poly sheeting and co-extruded films

Basic Poly Sheeting (Single-Layer Film)

- Single-layer LDPE or LLDPE film — blown or cast extrusion
- Low cost, widely available, easy to cut and overlap
- Low tensile and puncture resistance — tears easily under foot traffic or tool contact
- Permeance varies significantly with film quality and thickness
- Best use: temporary protection, under-slab in low-demand residential, short-term ground cover

Co-Extruded Multi-Layer Film

- 3 to 5 layers of different PE grades fused in a single pass — bonded at molecular level
- Better uniformity than basic poly, improved puncture resistance, good perm performance
- No structural reinforcement layer — performance still relies on film elongation under load
- Quality varies significantly by manufacturer formulation — virgin vs. recycled resin matters here too
- Best use: crawl space encapsulation in standard residential with moderate traffic, basement floor coverage

Premium Product Types

Cross-woven laminates, radiant barriers, and drainage composites

Cross-Woven PE Laminate

- Three-ply: film / woven HDPE scrim / film — extrusion-coated, virgin resin throughout
- Exceptional tensile, puncture, and tear strength — load distributed across woven architecture
- Stable perm performance, Class A ASTM E1745, available 7–20 mil
- Best use: full encapsulation, high-traffic, commercial, radon, permanent installations

Radiant Barrier

- Foil-faced product — reflects radiant heat in addition to blocking moisture vapor
- Best use: hot climates where summer heat gain through floor is a co-concern
- Not a substitute for cross-woven PE in moisture-critical applications — adds thermal, not structural performance

Drainage Composite (Dimple Mat)

- Dimpled HDPE core creates drainage cavity — channels bulk liquid water to collection point
- Best use: wet basement walls with active seepage — manages water that a vapor barrier alone cannot
- Often specified together with a vapor barrier, not instead of one

Reading the Spec Sheet

Key performance metrics and what they mean

Metric	Value / Result	What it means
Tensile Strength (after soaking)	Class A: 209 lbf/in MD, 179 lbf/in TD (20-mil)	*Tested wet — because that's how it lives in a crawl space*
Puncture Resistance (ASTM D1709)	Class A: > 3,000 grams (20-mil)	*More than a sharp rock, a screw, or a boot heel*
CBR Puncture (ASTM D6241)	> 970 lbf (20-mil)	*Sustained point load resistance — HVAC equipment, pipe fittings*
Water Vapor Permeance (ASTM E96 B)	0.019 perms (20-mil) — Class I	*5x better than the Class I threshold of 0.1 perms*
Flame Spread (ASTM E84)	Class A — permanently exposed space approved	*Required for any product installed in an accessible crawl space*

The Five Questions to Ask on Every Job

A decision framework for product specification

01 **Moisture load?**

Climate zone, past events, visible staining, soil conditions, water table

02 **Traffic & access?**

Will anyone enter after install? HVAC service? Cross-woven when yes.

03 **How permanent?**

Temporary fix vs. lifetime-of-structure installation

04 **Code & spec requirements?**

Local IRC adoption, engineer spec, radon mitigation requirements

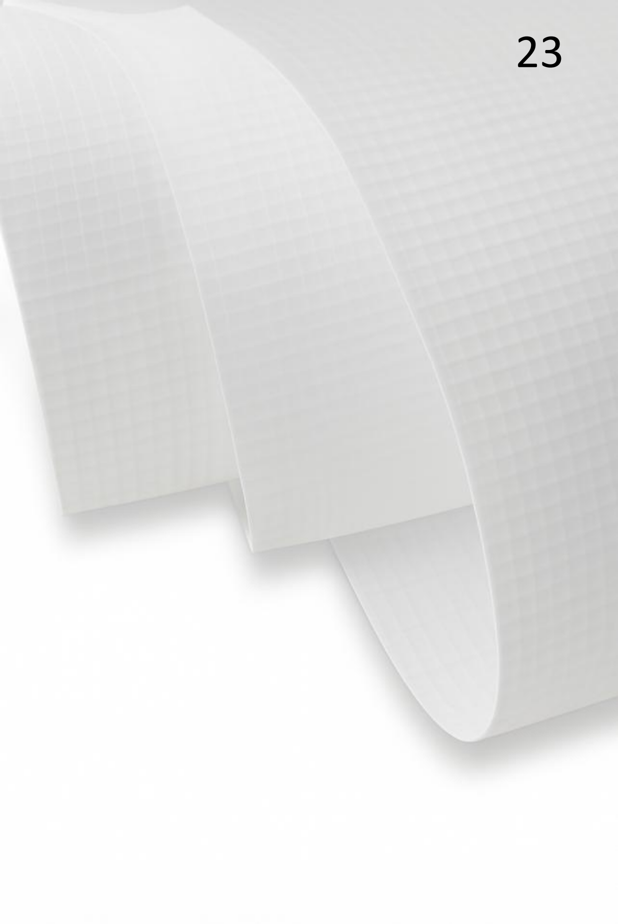
05 **What is the true cost?**

Material + labor + callback risk. Durability always saves money long-term.

Matching Product to Application

Quick reference — field and exam

Application	Minimum	Professional Spec
Crawl Space — Full Encapsulation	12-mil Cross-Woven Class A	**16–20-mil Cross-Woven Class A**
Crawl Space — Ground Cover Only	6-mil poly (IRC minimum)	**12-mil Cross-Woven**
Basement Floor	10-mil film or cross-woven	**12-mil Cross-Woven**
Basement Wall (active seepage)	Drainage composite	**Drainage composite + barrier**
Under-Slab — Residential	Class C ASTM E1745 (6-mil)	**Class A 12-mil Cross-Woven**
Under-Slab — Commercial	Class A 12-mil Cross-Woven	**Class A 16–20-mil Cross-Woven**
Radon Mitigation Membrane	12-mil Cross-Woven < 0.1 perms	**20-mil Cross-Woven < 0.1 perms**



Crawl Space Encapsulation in Detail

The highest-demand application for vapor barriers

- Full encapsulation = continuous coverage: ground AND all foundation walls
- Minimum professional spec: 12-mil cross-woven laminate, Class A ASTM E1745
- 16-mil: commercial or homes with active HVAC equipment in crawl space
- 20-mil: high-traffic access, radon mitigation primary membrane, maximum longevity
- Wall coverage: run barrier up to within 3" of sill plate — termite inspection gap
- Ground-only liner in a full encapsulation job is an incomplete job

Why cross-woven for encapsulation: The liner must survive installation traffic, HVAC service, thermal cycling, and continuous contact with moist soil — for decades. Film-only products are not engineered for this.

When a Barrier Is Not Enough

The integrated moisture management system

Vapor Barrier

Manages moisture vapor from soil. The foundation of the system. Does not manage bulk liquid water.

Drainage System

Interior drains, dimple mats, sumps manage bulk water. A barrier alone cannot handle hydrostatic pressure.

Dehumidification

Controls residual humidity in conditioned crawl spaces. A sealed space without dehumidification can still have elevated RH.

Air Sealing

Vapor moves with air. Band joists, penetrations, and entries must be sealed — the barrier doesn't cover what air bypasses.

Why the Material Determines the Outcome

What the science explains about field performance

Starting point: You know how to install. What the material determines is whether your work holds up for 1 year — or 20.

Tape adhesion is a material question

- Virgin-resin PE has predictable surface chemistry. Filler particles reduce bonding area — the same tape performs differently on a filled product. This is a formulation variable, not a technique variable.

Puncture resistance over time

- The scrim distributes point loads across the weave. A film concentrates them. This difference is measurable on day one and is still the difference after 1,000 service footsteps.

Thermal cycling and micro-cracks

- Low elongation caused by fillers means cracks initiate under repeated seasonal movement. Virgin-resin film at 700% elongation has enormous reserve. A filled product at 150% does not.

What Decades of Performance Actually Requires

The material properties that determine longevity

Virgin resin — why it matters for longevity

- Consistent molecular chain structure = predictable elongation, tensile, and surface chemistry across years
- No contaminants from mixed polymer streams that degrade under sustained moisture exposure
- Warranty reflects a manufacturer's confidence in their formulation — not just initial test results

What fails early — and why

- Filler particles create micro-voids under thermal cycling — slow, progressive, not visible on day one
- Recycled resin introduces batch-to-batch variability in elongation and surface energy
- Both factors manifest years after installation — when the callback lands, the product choice is long forgotten

Five Things to Take Out of This Room

1	**Mil ≠ Quality**	Always ask for weight per MSF and tensile data alongside thickness.
2	**Filler is not polyethylene**	Two 20-mil products are not the same. Request resin composition and compare weights.
3	**Class A is the benchmark**	For permanent crawl space encapsulation, Class A ASTM E1745 is the minimum — not the maximum.
4	**Material = long-term performance**	Virgin resin, no fillers, woven reinforcement — this is what a barrier looks like after a decade.
5	**The barrier is one component**	It works best alongside drainage, dehumidification, and air sealing.

Questions?

- "Has anyone compared the weight of two same-mil products side by side?"
- "Has anyone had a barrier fail in the field? What was the failure mode?"
- "What do you tell a client who asks for the cheapest liner that meets code?"

Thank you.

The Liner Guys · Direct-from-Manufacturer Cross-Woven PE Vapor Barriers

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