



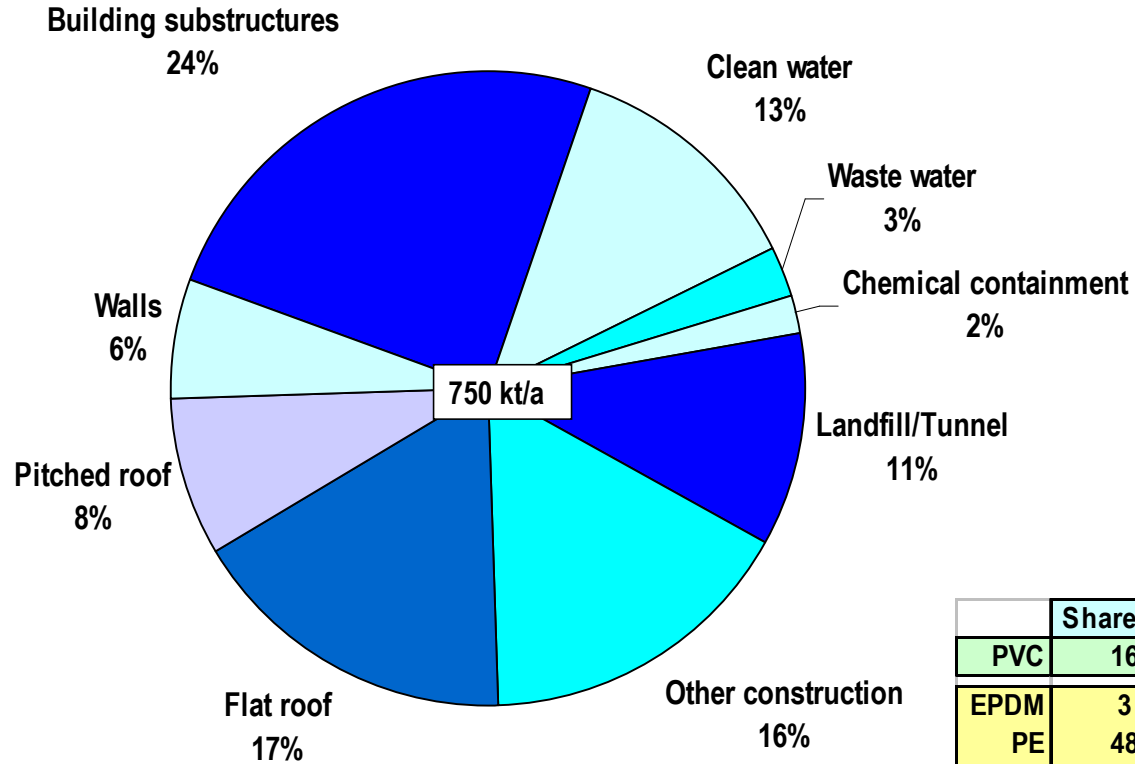
Addressing Global Waterproofing with a Unique Polymer Portfolio

Stefan Ultsch, Mercedes Alonso – Dow Europe GmbH

Lamy Chopin, Damien Polansky – The Dow Chemical Company

- **Waterproofing Markets and Applications**
- **Technical Trends and Requirements**
- **The Dow Polymer Portfolio in Waterproofing**
- **A Toolbox for Tailored Waterproofing Solutions**

European polymer usage in Waterproofing Membranes



	Share [%]	Volume [kt/a]
PVC	16	120
EPDM	3	25
PE	48	360
PP	33	250
	84	635

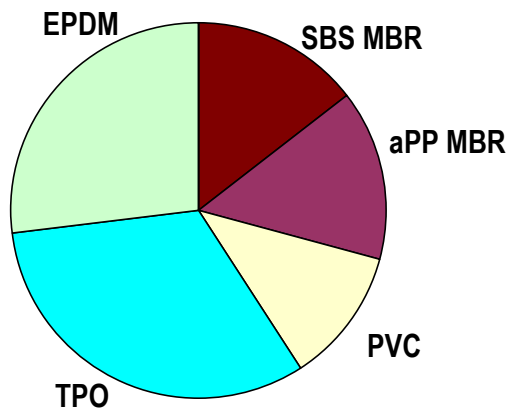
Source: AMI 2007

Selected Single-Ply Roofing Markets by Polymers in 2008



North America

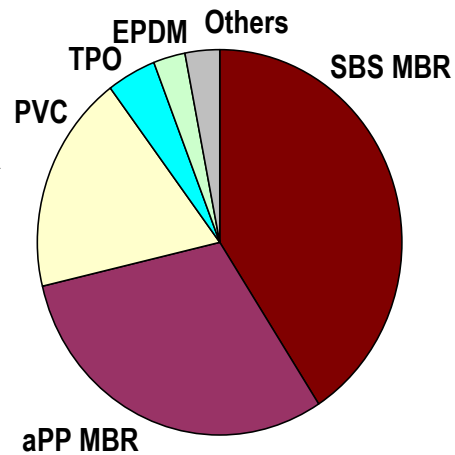
310MM m²/a
5% growth/a



Source = SPRI

Western Europe

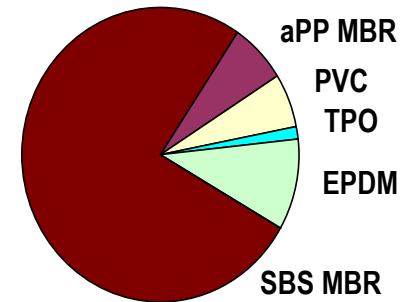
320MM m²/a
2.5% growth/a



Source = Dow internal

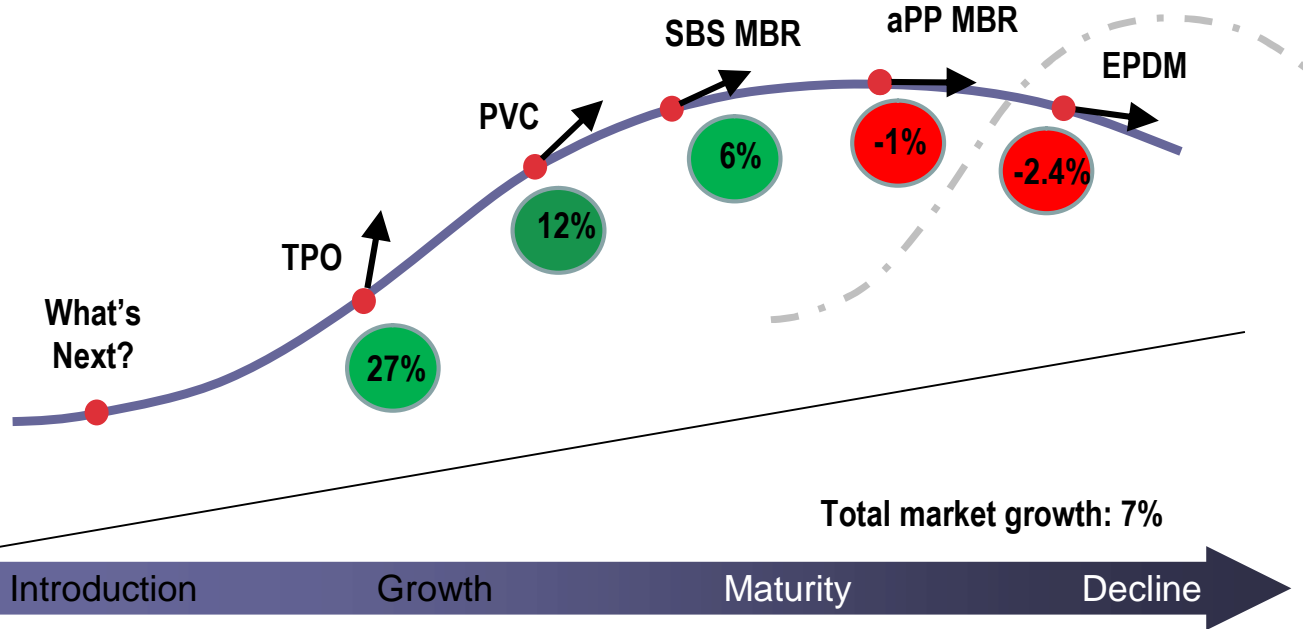
China

180MM m²/a
19.5% growth/a



Source = Dow internal

Consolidated Growth Rates for North America,
Western Europe and China



Roofing



Unballasted

Ballasted

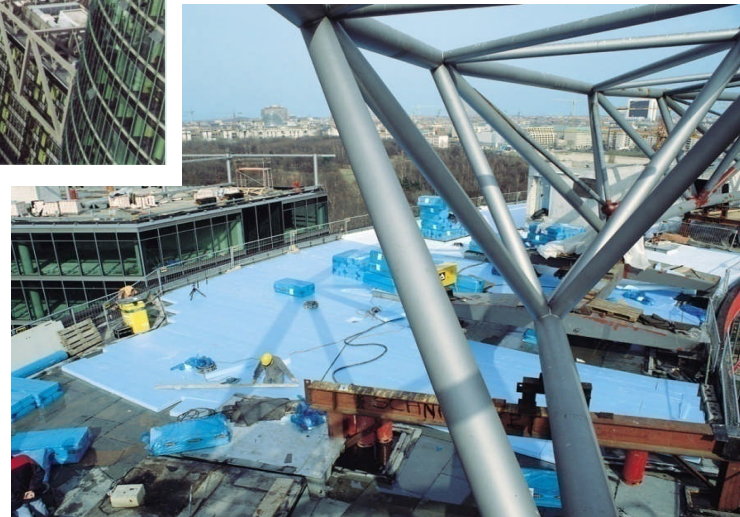


Green roof

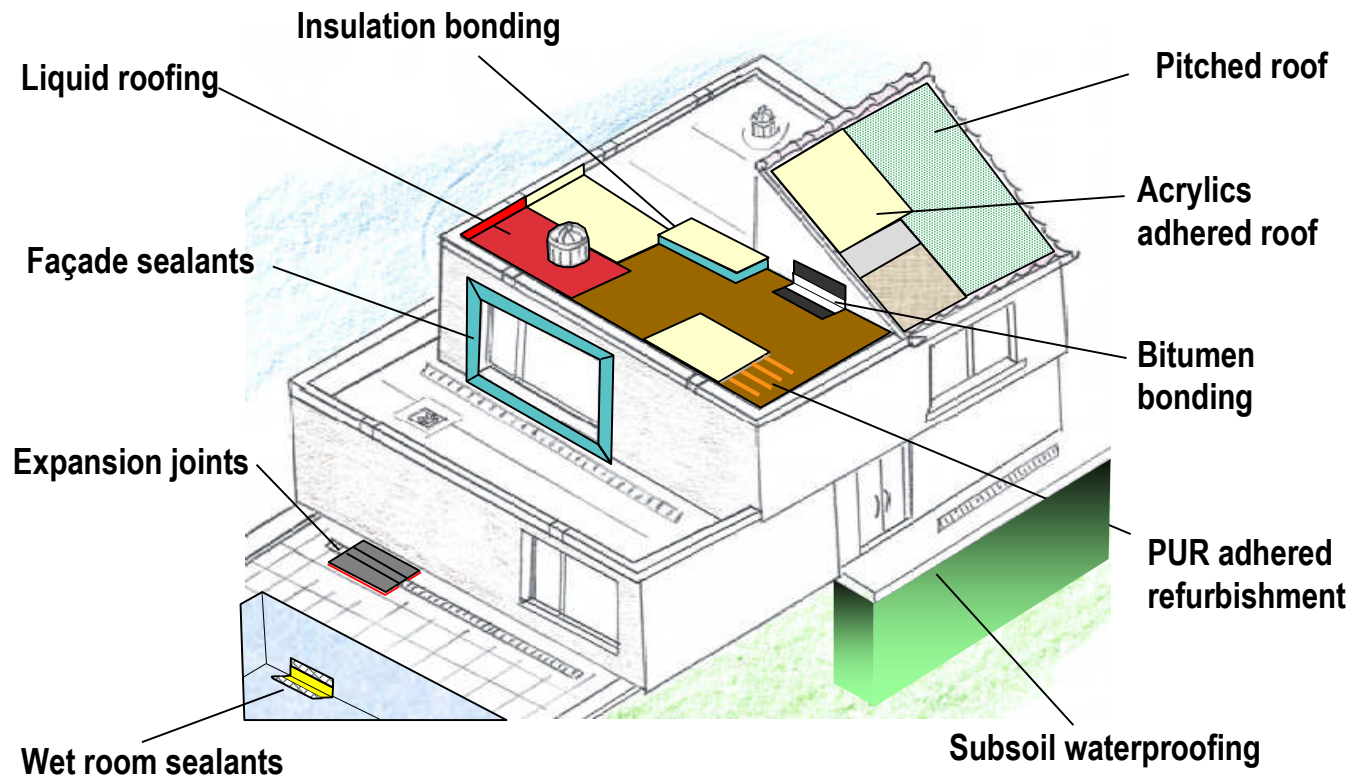
Geomembranes, Water Management, Tunnel Liners



Modern Architecture



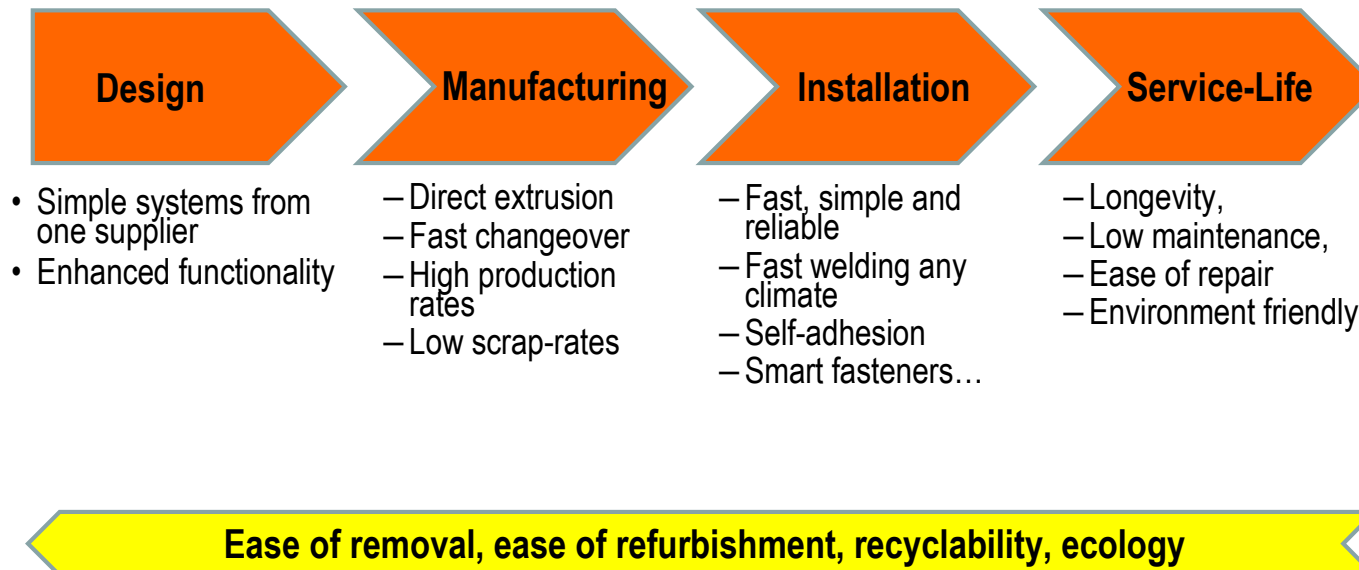
Waterproofing in Civil Engineering



Trends in Waterproofing



Reduction of Total System Cost

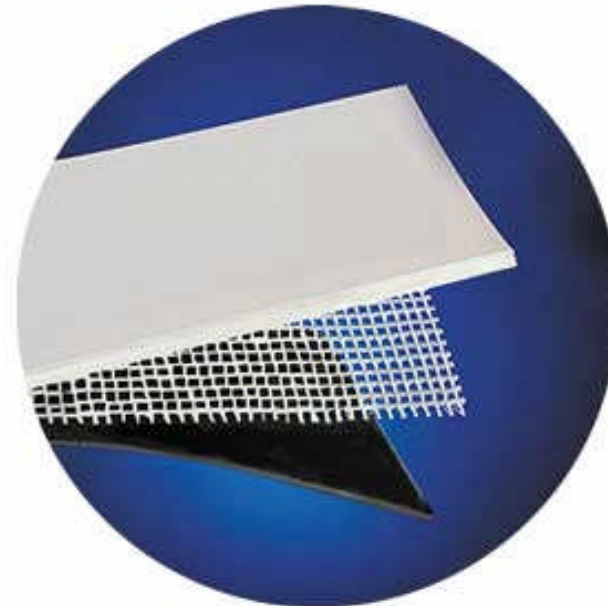


Requirements of Waterproofing Membranes

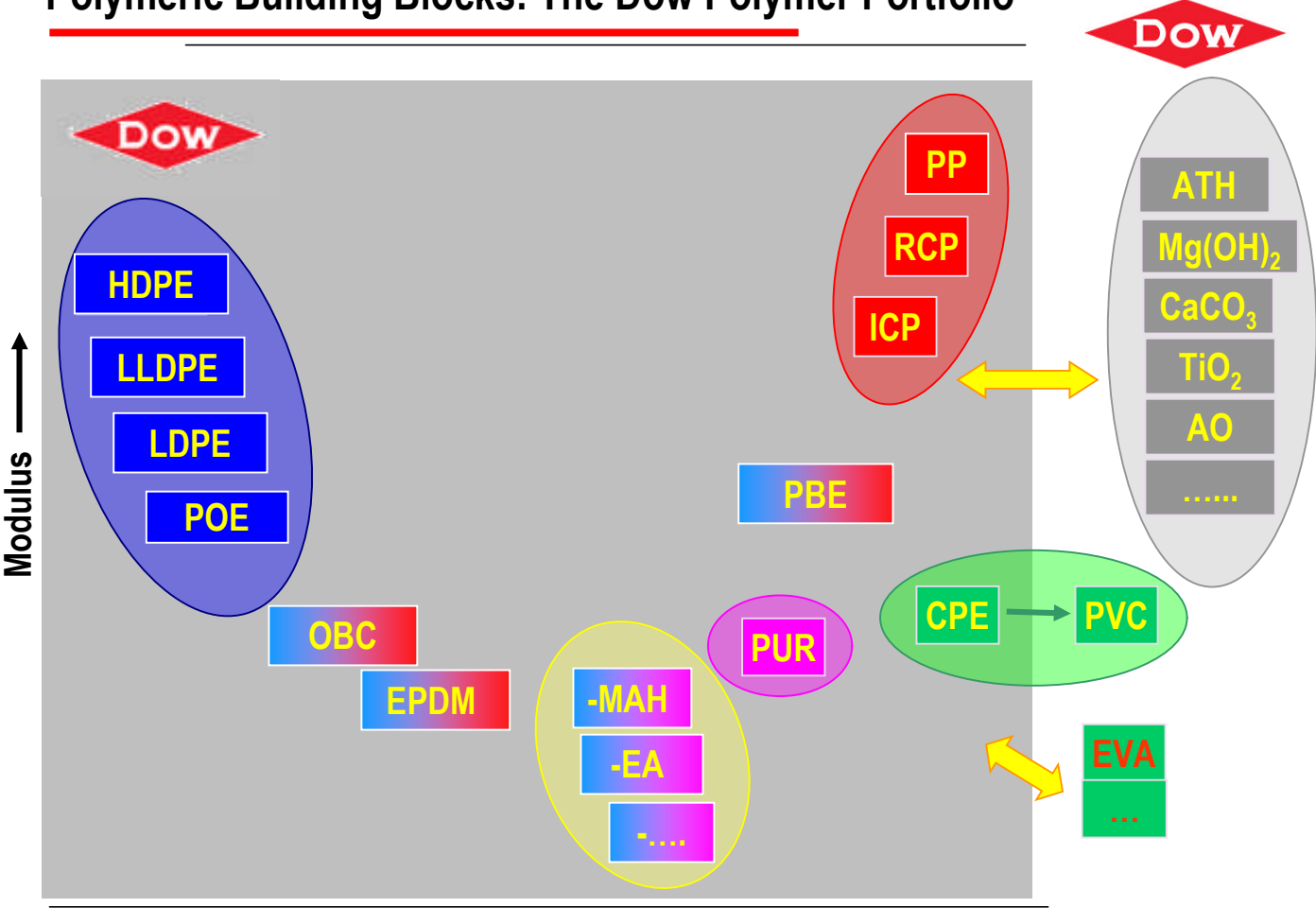


- Flexibility
- Easy and reliable welding
- Cold temperature resistance
- Cold contraction
- Heat resistance
- Puncture resistance
- Chemical resistance
- Weathering
- UV-resistance
- Fire resistance
- Root resistance
- Energy efficiency
- Drinking water approvals
- ...

• = most critical



Polymeric Building Blocks: The Dow Polymer Portfolio



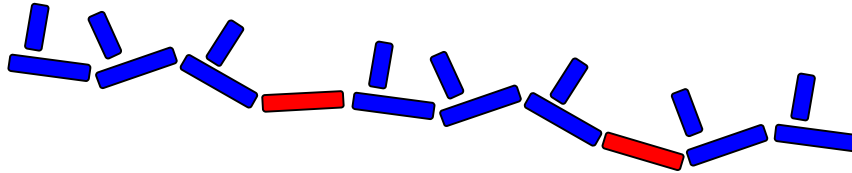
Dow Polymers in Building and Construction Membranes



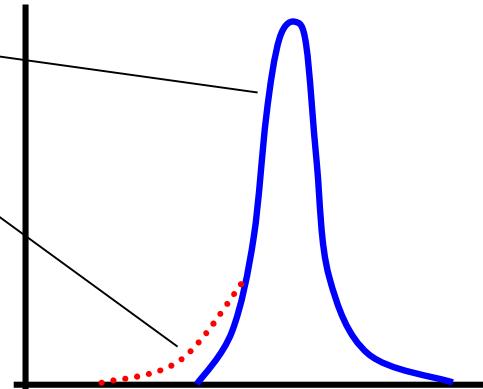
		Roofing		Geomembranes				Tapes		Others		
		Single-ply low slope	Pitched roof, vapor barriers	Reservoir liners	Landfill	Perimeter liners	Tunnel liners	Wet room, Façade	Expansion joints	Tank and Pool liners	Bitumen modification	Banners, Tarpaulins...
INSPIRE*	PP	•	•	•	•	•	•		•			
ELITE*	EPE		•	•	•	•	•			•		
DOWLEX*	LLDPE		•	•	•	•	•			•		•
LDPE	LDPE		•	•	•	•	•					•
ENGAGE*	POE	•	•	•	•	•	•	•	•	•	•	•
NORDEL*	EPDM	•		•				•	•	•	•	
VERSIFY*	PBE	•	•	•	•	•	•	•	•	•	•	•
TYRIN*	CPE	•							•	•		•

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- Polymerization of a high-molecular C3/C2-copolymer
- Based on INSITETM catalyst technology

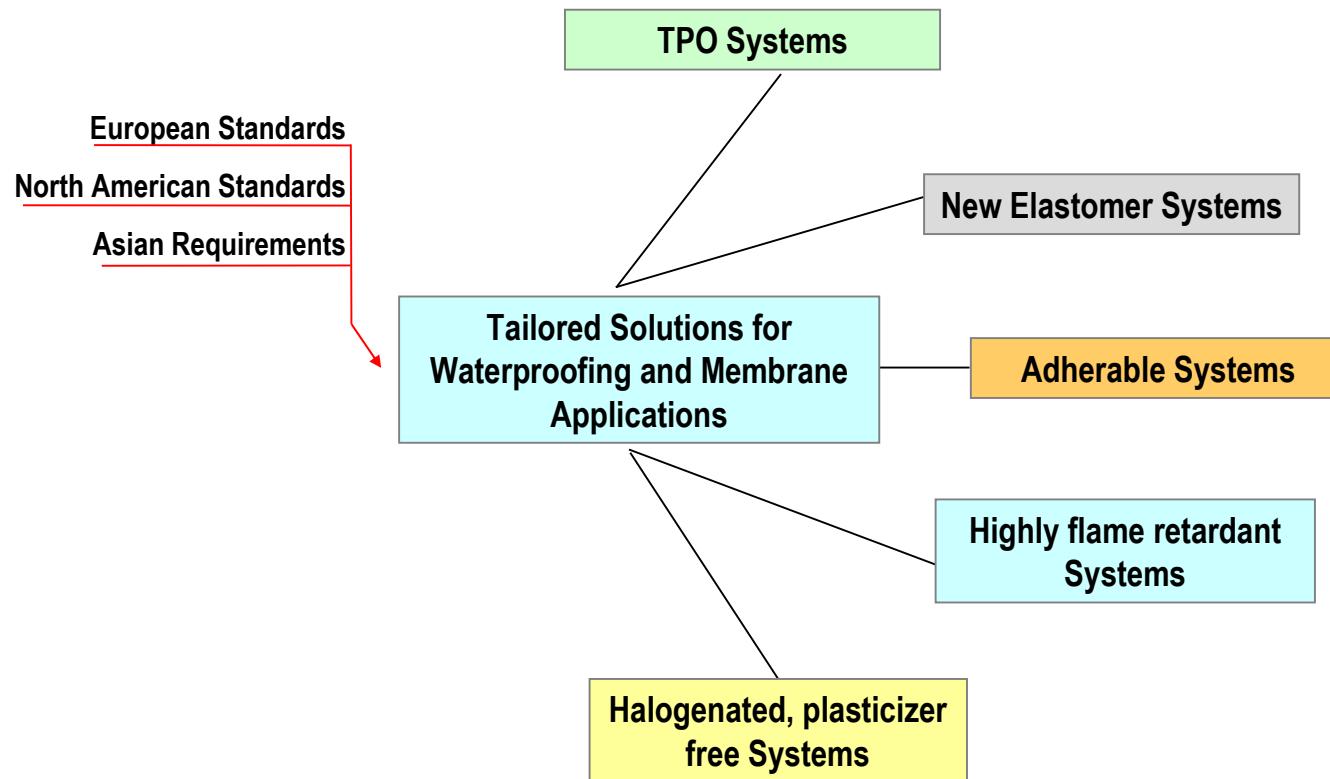


- No reactor blend, no reactor cascades, no vis-break process
- Tailored, tight tolerance molecular structure
- No oligomers, no low-molecular fraction
- **Excellent and lasting heat welding**
- **Excellent filler uptake and general properties**

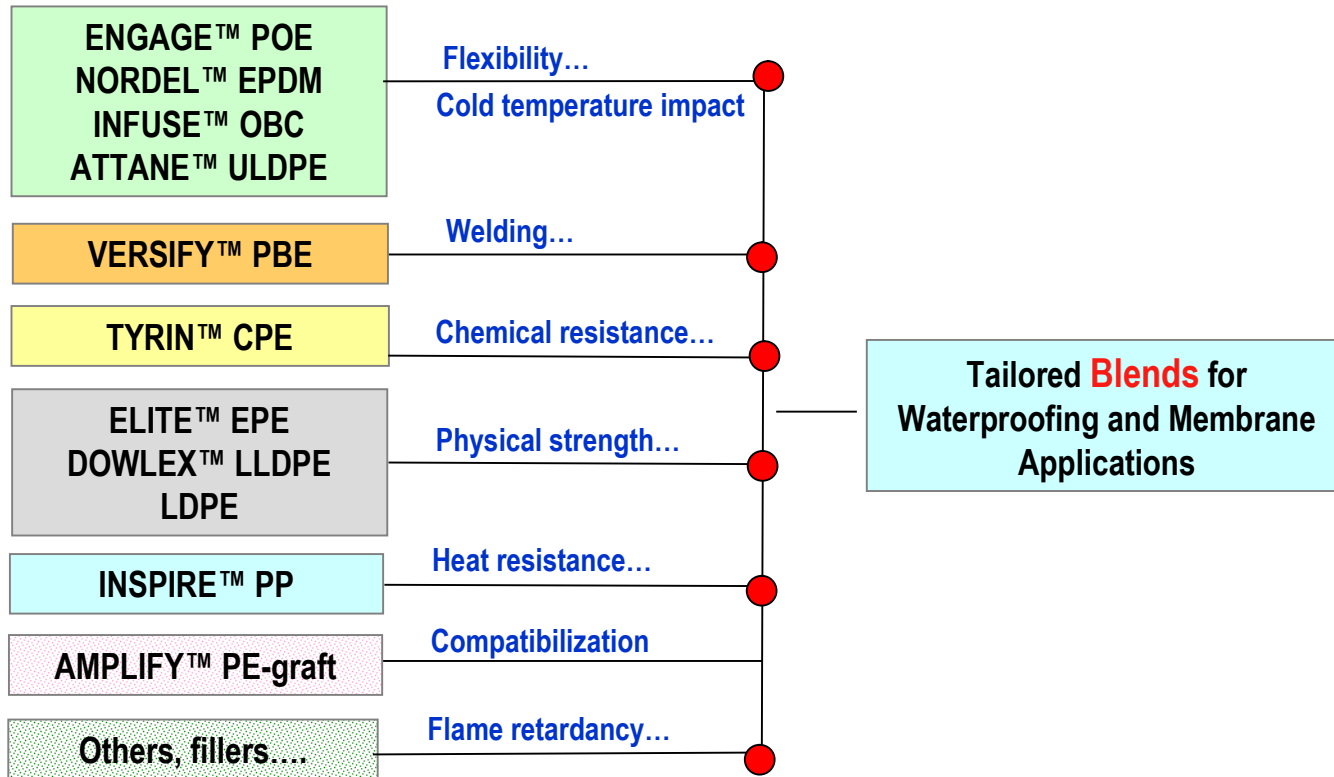


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Formulation Toolbox: Various Concepts



Designing the Formulation Toolbox



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Processing: Direct Extrusion of FR Compounds

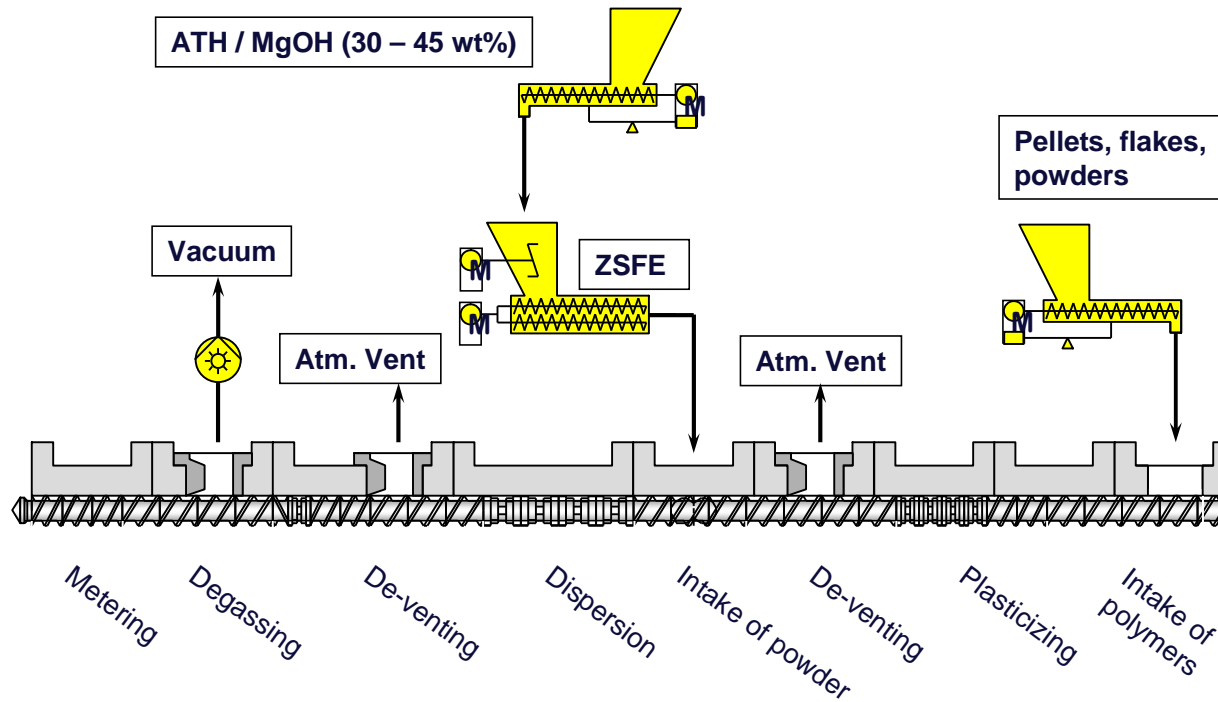


Diagram courtesy of BERSTORFF, Hanover Germany

Lab-scale Direct Extrusion Line

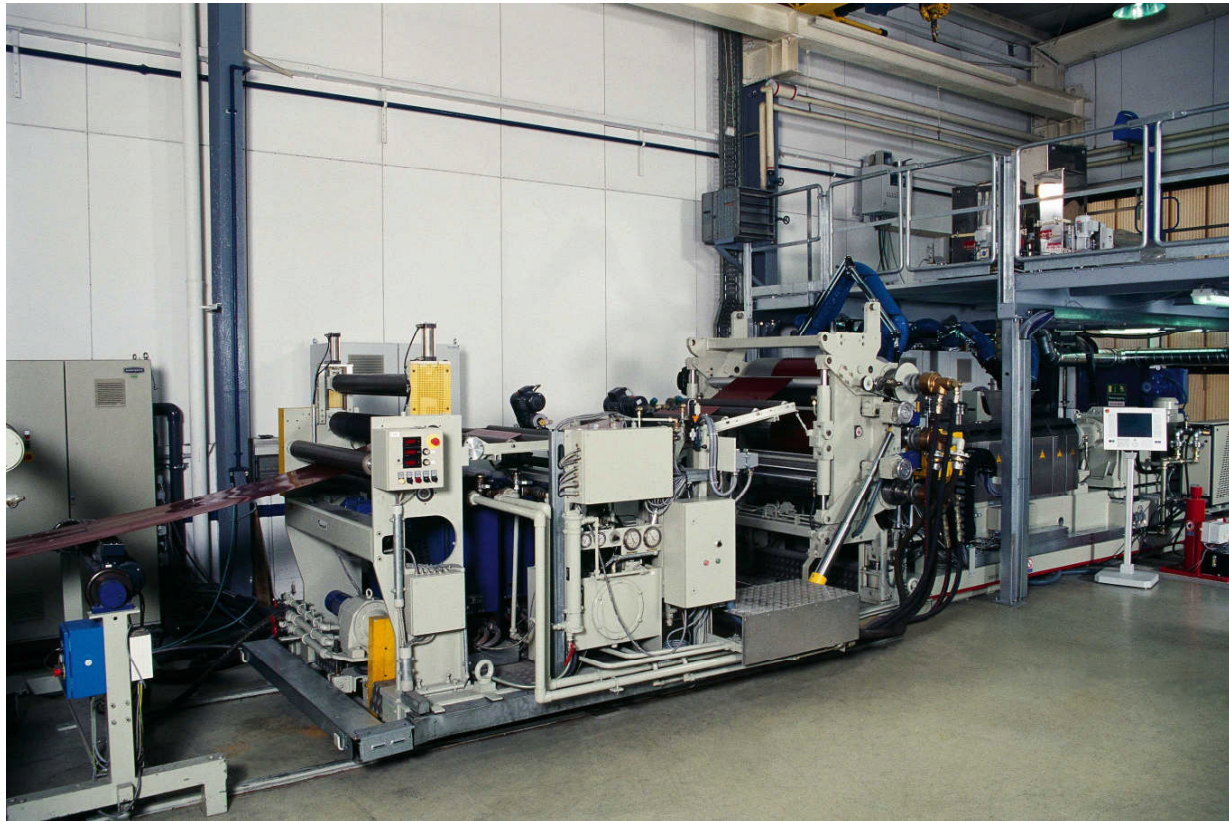


Photo courtesy of BERSTORFF, Hanover Germany

VERSIFY™ Processing on Direct Extrusion Lines



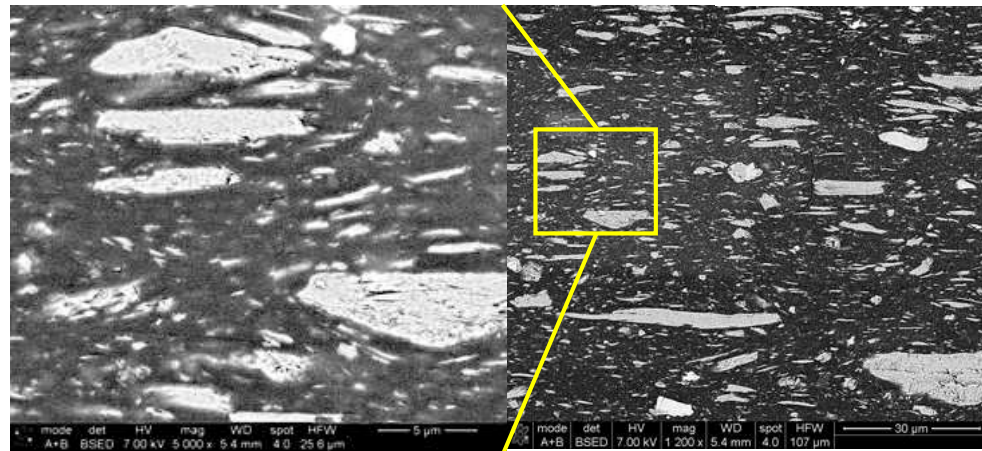
Formulations based on VERSIFY™ Plastomers and Elastomers provide:

- Low extrusion temperatures
 - High outputs and low torque
 - Low die pressure
-
- Excellent dispersion of fillers and flame retardants
 - Excellent blend homogeneity
 - Excellent overall properties

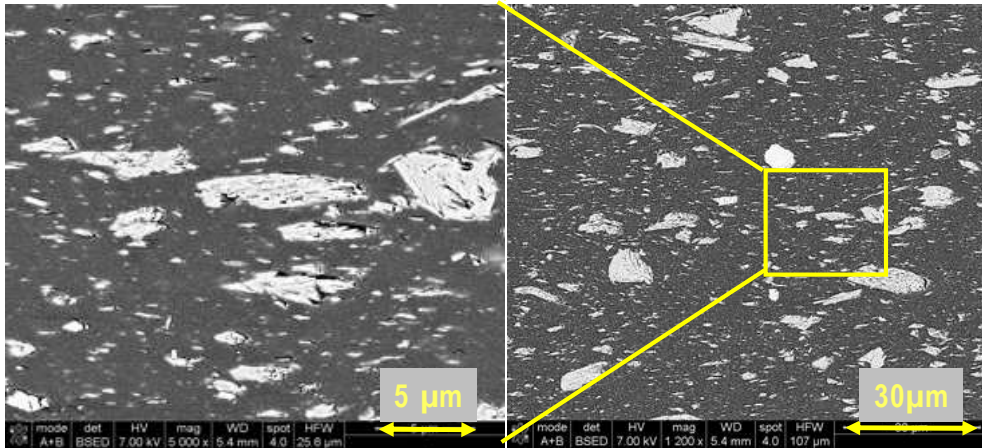
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TPO Direct Extrusion Study, 35% MgOH₂

Incumbent

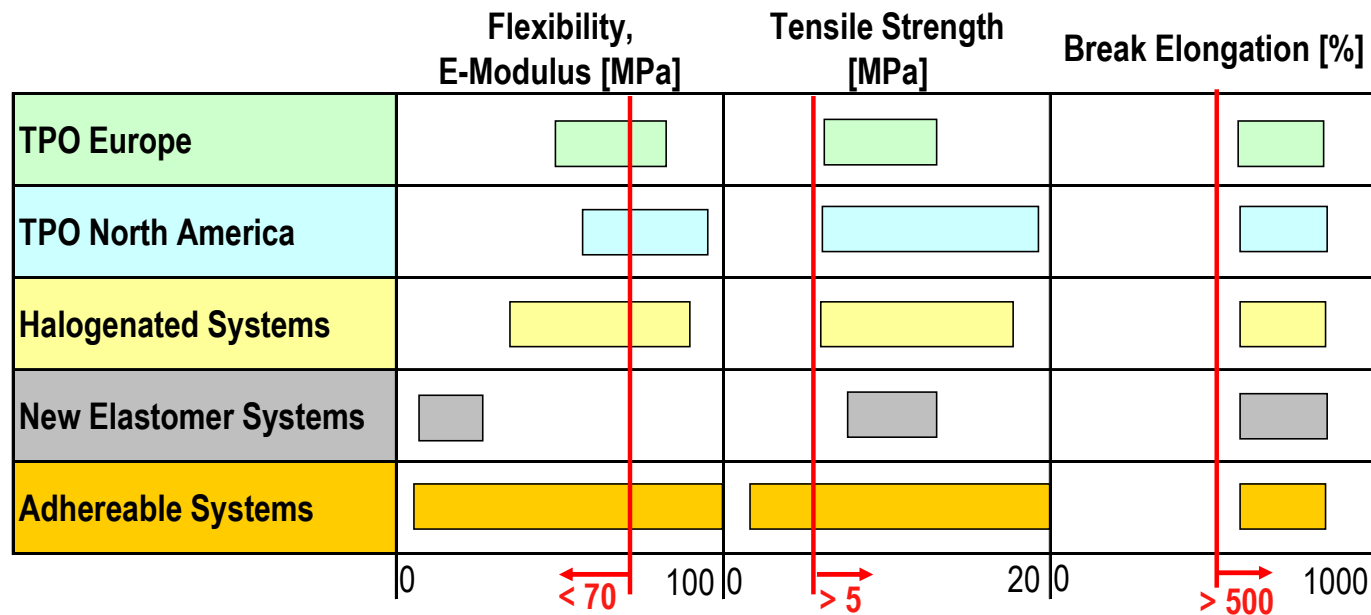


70% VERSIFY™ 2300
30% icPP



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Adjustable Properties: Flexibility and Mechanical Strength



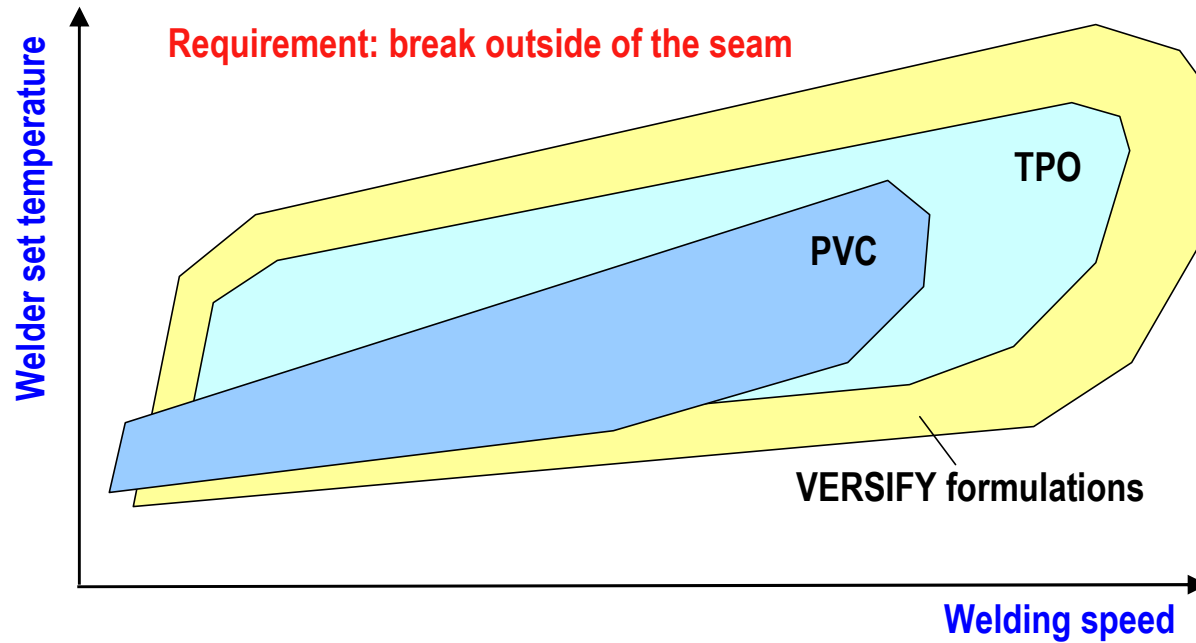
— Requirement / State of the Art

Adjustable Properties: Temperature Resistance



	TMA (Thermomechanical Analysis)		DSC
	3 mm pin, 1 N load, 5 K/min		Calorimetry
	1.5 mm membrane thickness		10 K/min, second run
	0.25 mm penetration temperature [°C]	0.50 mm penetration temperature [°C]	melting range [°C]
TPO Europe			
TPO North America			
Halogenated Systems			
New Elastomer Systems			
Adhereable Systems			
	50 → 150	50 → 150	100 → 200
	Requirement / State of the Art		

The Welding Window



VERSIFY™ Plastomers and Elastomers provide:

- Excellent and consistent welding due to low oligomer level

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Flame Retardancy



- **Halogen-free flame retardants** are in main use today
 - Aluminum trihydrate $\text{Al}(\text{OH})_3$ decomposition at 200 °C
 - Magnesium hydroxide $\text{Mg}(\text{OH})_2$ decomposition at 300 °C
- **Addition level** depends on norm and system requirements:
 - 30 wt% in North America 40 to 50 wt% in Europe
- **Purity, particle size distribution, surface coating** affect membrane manufacturing, end properties and may be decisive for long-term/weathering performance

VERSIFY™ based formulations and flame retardants:

- Low melt temperature processing allows high production rates with $\text{Al}(\text{OH})_3$
- Very high filler loads without loss of mechanical properties
- **Can match with most stringent requirements**

Weathering and UV-Resistance



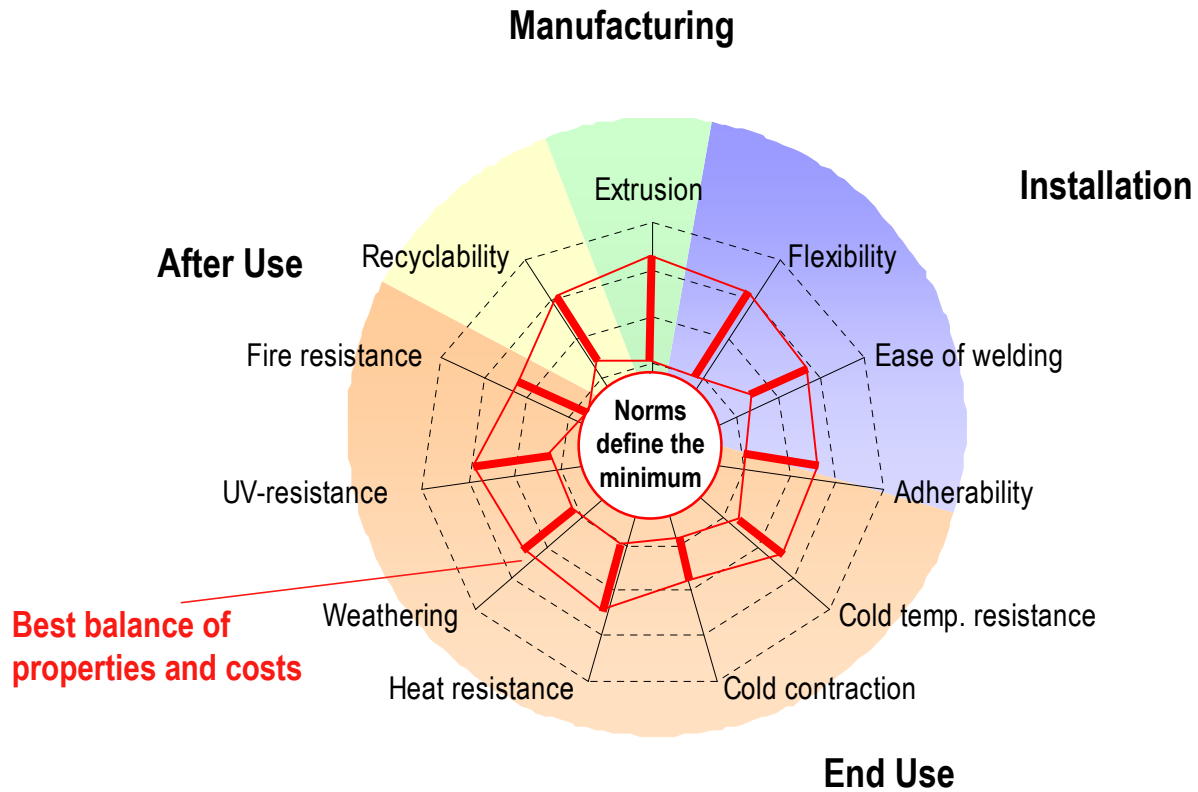
- **Processing and longterm stabilizer packages** are key for longevity and are added in amounts of 0.05 to 1.5 wt%, often via master batches
- **Titanium dioxide (TiO₂)** 2 to 5 wt% are added as colorant and UV-stabilizer
- **Carbon black** 0.01 to 0.05 wt% for greyish membranes improves UV-stability

VERSIFY™ based formulations and stabilizers:

- **High stabilizer levels possible without negative effects on welding**
- **VERSIFY™ formulations can be tailored to any state of the art longevity level**
- **VERSIFY™ based formulations have a proven track record**

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The Formulation Toolbox



Installation of a TPO Membrane on Dow Premises



Summary



Markets

- Global waterproofing applications require different solutions
- TPO roofing is growing substantially

Dow offers

- A unique portfolio of proven polymers for tailored solutions
- Excellent technical expertise and global presence

Dow polymers

- NORDEL™ EPDM is #1 in EPDM waterproofing
- DOWLEX™ PE , AFFINITY™ POP, ENGAGE™ POE: #1 in geomembranes and tunnel liners
- VERSIFY™ PBE is key in commercially proven, high-performance membranes
- Other Dow Elastomers enable specific functionality and tailored solutions

Let us be the partner in developing your Waterproofing System

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Appendix Dow Tradename Products



- **AFFINITY™ Polyolefin Plastomers**
- **AMPLIFY™ Functional Polymers**
- **ATTANE™ Ultra Low Density Polyethylene Resins**
- **DOWLEX™ Linear Low Density Polyethylene Resins**
- **ELITE™ Enhanced Polyethylene Resins**
- **ENGAGE™ Polyolefin Elastomers**
- **INFUSE™ Olefin Block Copolymers**
- **INSPIRE™ Performance Polymers**
- **NORDEL™ IP & MG Hydrocarbon Rubber**
- **TYRIN™ Chlorinated Polyethylene**
- **VERSIFY™ Plastomers and Elastomers**

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