

GUR[®] UHMW-PE as Battery Dry Binder Material

Dry Coating Forum, Dresden

Dr. David Ditter, Celanese Services Germany GmbH

November 4th, 2025

- ▶ Celanese Company Introduction
- ▶ Introduction to GUR® UHMW-PE
- ▶ GUR® UHMW-PE as Battery Dry Binder Material

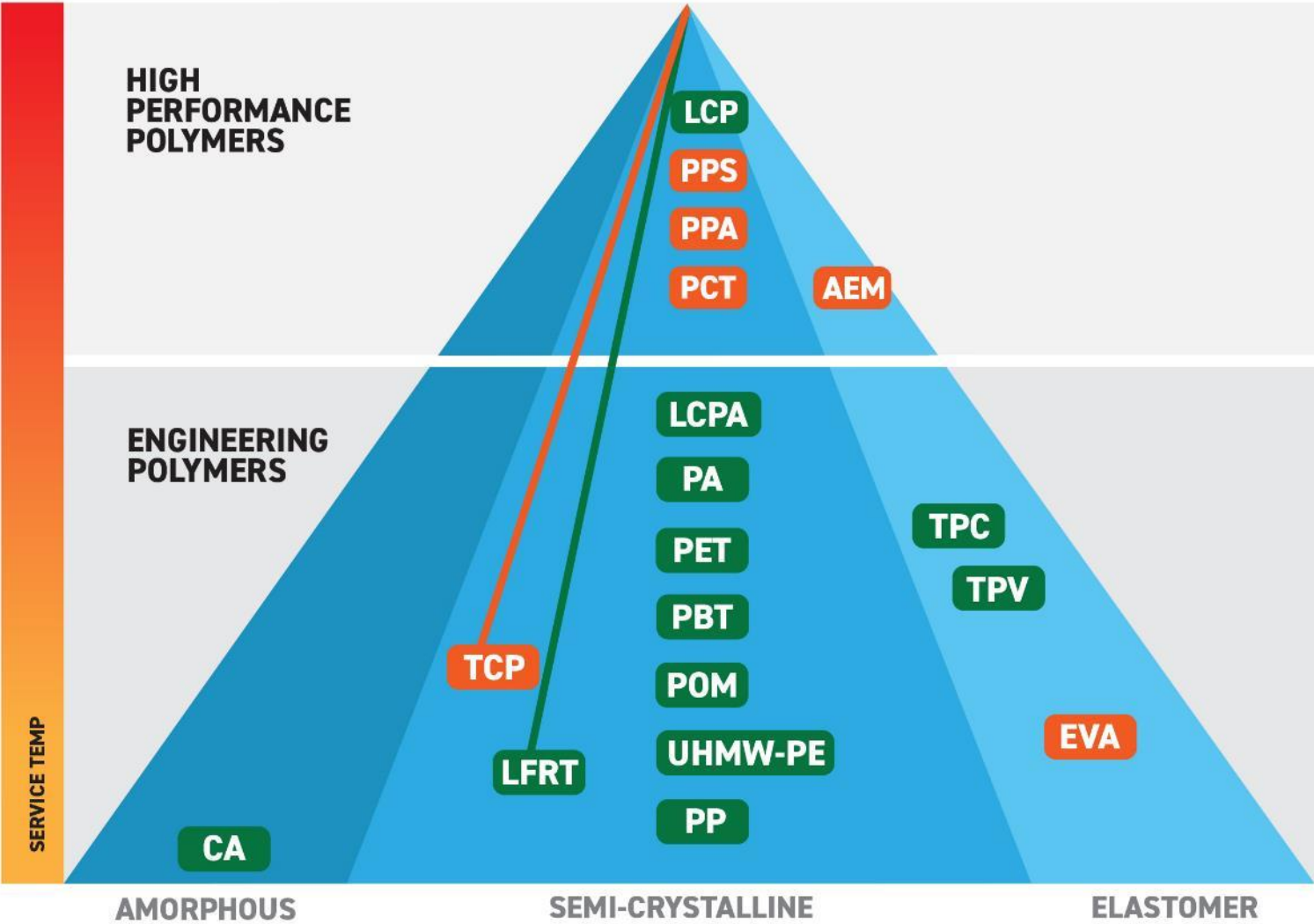
Celanese Company Introduction

Celanese Corporation Overview

We are a global chemical and specialty materials company that engineers and manufactures a variety of products essential to everyday living.

- Global headquarters in Dallas, Texas, USA
- \$10.3 billion in net sales in 2024
- More than 11,000 employees globally
- 56 owned and operated manufacturing locations; operations in 27 countries worldwide
- Two leading businesses: Engineered Materials and Acetyl Chain
- Innovation is at the core of our differentiated business model

Celanese Polymer Offerings



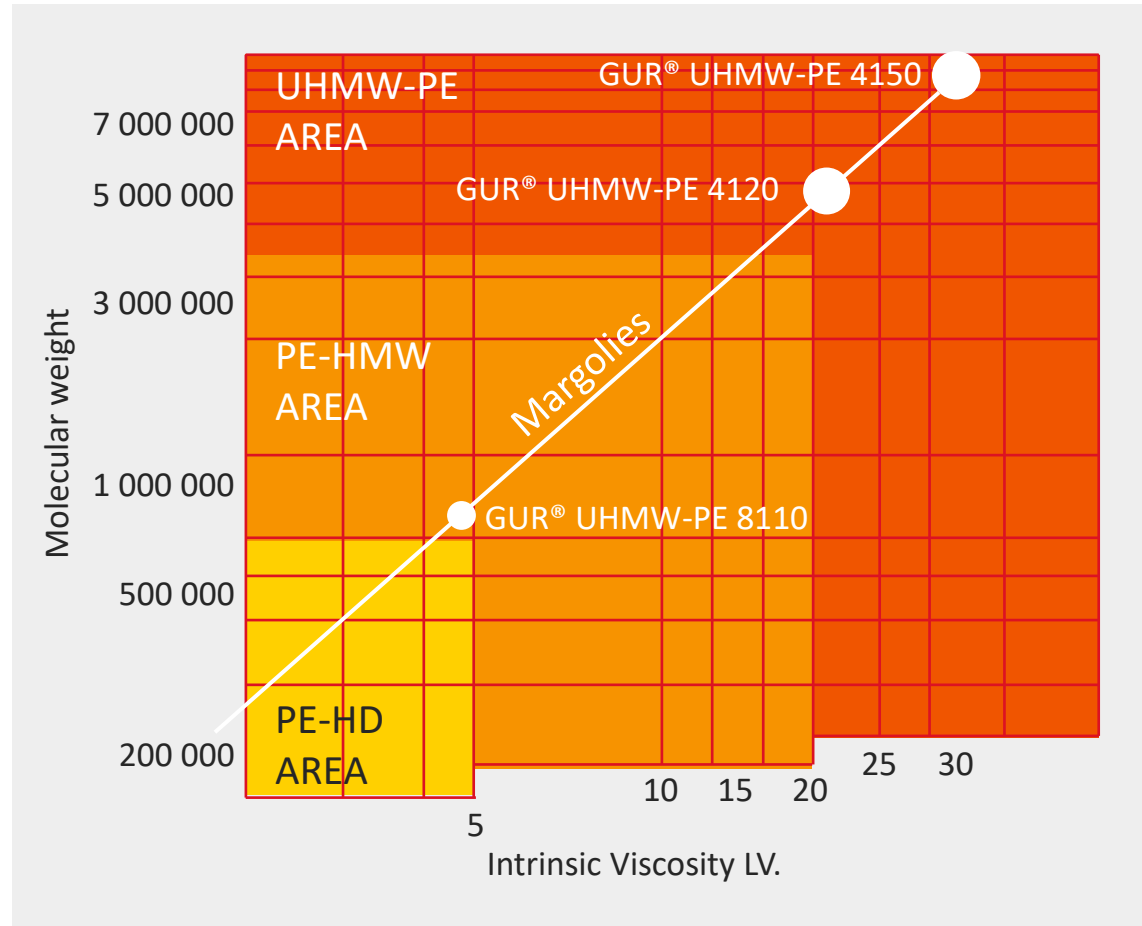
	POLYMER	TRADE NAME	SUSTAINABLE OPTIONS	INTEGRATION
SEMI-CRYSTALLINE	LCP	Vectra®, Zenite®	●	●
	PPS	Fortron®		●
	PPA	Zytel® HTN, Celanyl® XT, Frianyl® XT		●
	PCT	Thermx®		
ELASTOMER	AEM	Vamac®		●
SEMI-CRYSTALLINE	LCPA	Zytel® RS	●	●
	PA	Zytel®, Celanyl®, Frianyl®, Minlon®	●	●
	PET	Rynite®, Mylar®, Melinex®	●	
	PBT	Celanex®, Vandar®, Crastin®	●	●
	POM	Hostaform®, Celcon®	●	▲
	LFRT	Celstran®	●	
	UHMW-PE	GUR®	●	●
	PP	Tecnoprene®, Polifor®, Talcoprene®	●	
ELASTOMER	TPC	Hytrel®	●	●
	TPV	Santoprene®	●	
	EVA	Ateva®, VitalDose®		▲
AMORPHOUS	CA	Clarifoil®	●	●

● Traditional ● Available in sustainable ▲ Integration into Polymers and Raws ● Integration into Polymers

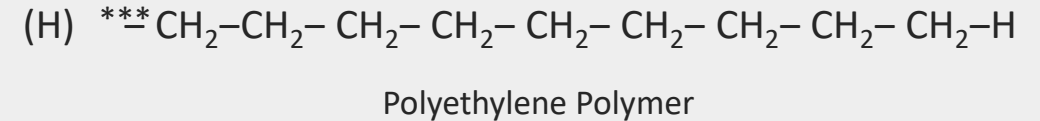
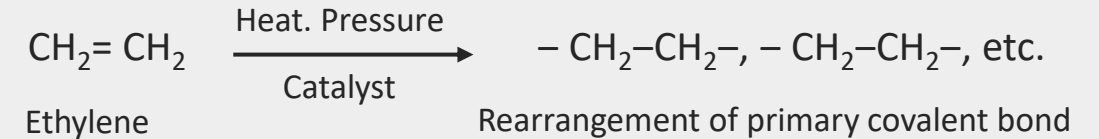
Updated 3/11

Introduction to GUR[®] UHMW-PE

The Polyethylene Family



Linear PE = High Density PE = Low Pressure PE



Typical Molecular Weight Ranges of Low-Pressure PE

- ▶ HDPE: 30 000 – 300 000
- ▶ HMW-PE: 300 000 – 3 Million
- ▶ UHMW-PE: 3 – 12 Million

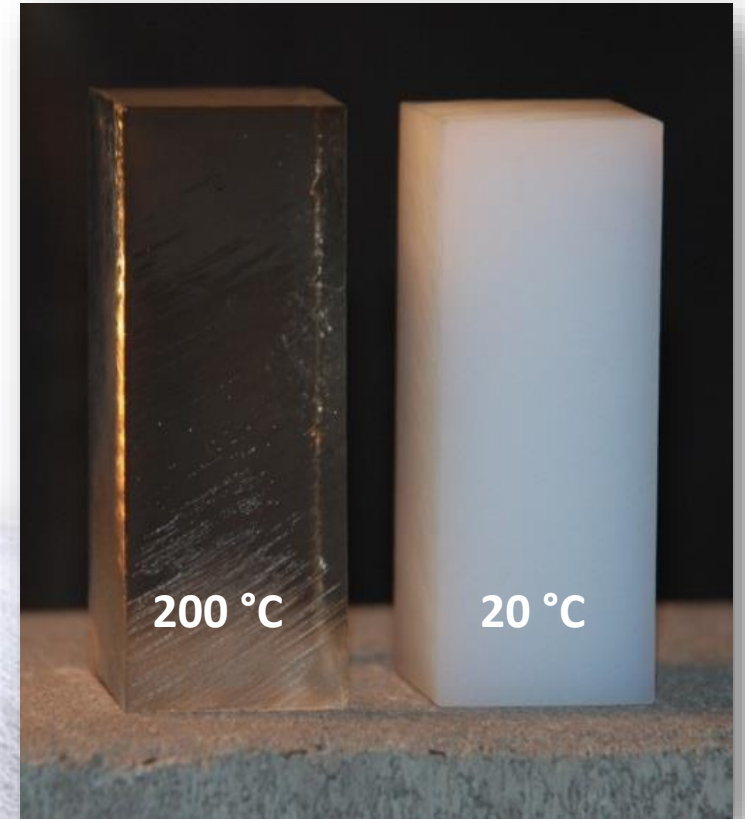
Definition of UHMW-PE:

- ▶ ISO 11542-1: MFR < 0.1 g/10min (190°C / 21.6 kg)

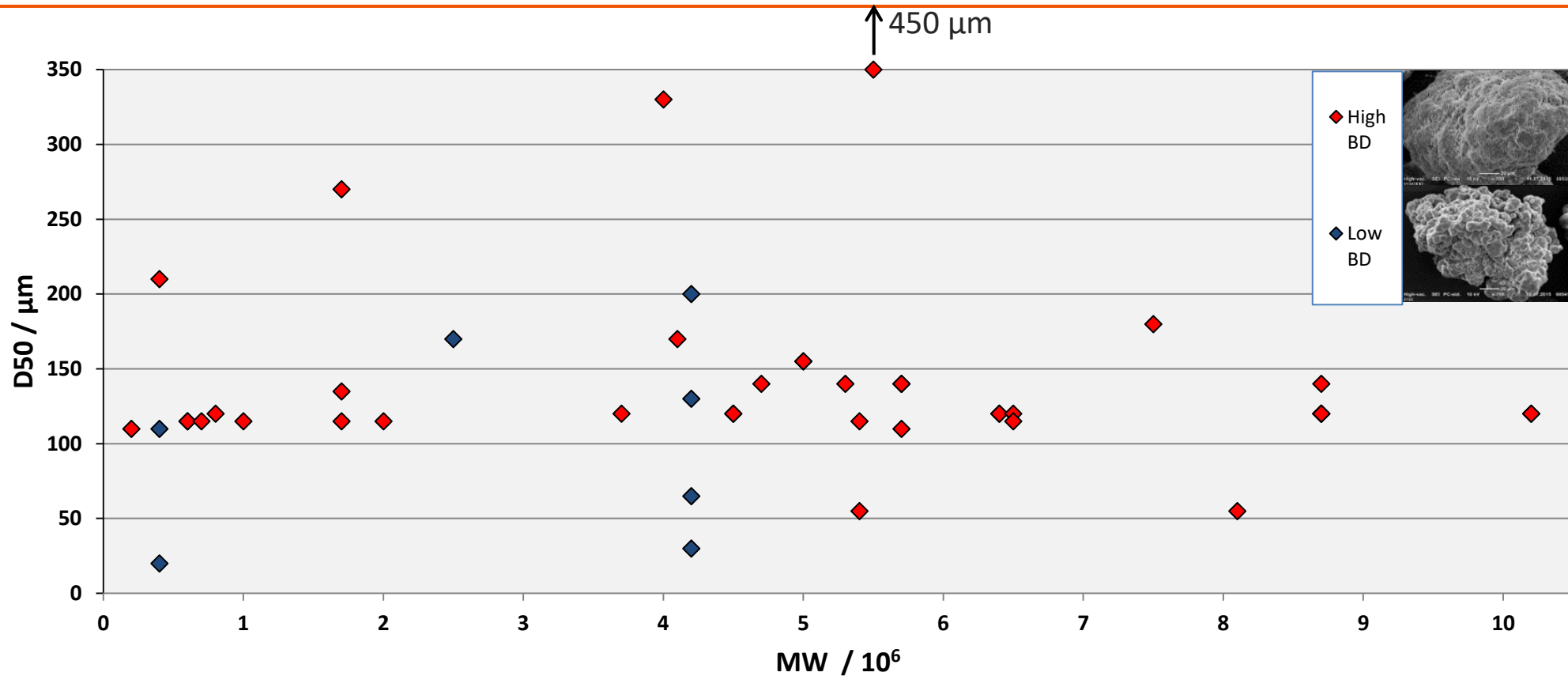
General Properties of GUR® Ultra High-Performance Polyethylene Powder

- ▶ GUR® UHMW-PE is a white powder
- ▶ Melts at 135°C but does not flow
- ▶ Outstanding abrasion resistance
- ▶ Highest impact strength of any polymer
- ▶ Low coefficient of friction
- ▶ Superior chemical resistance

- ▶ Physiologically safe (FDA compliant)
- ▶ Low density
- ▶ Excellent dielectric and insulating properties
- ▶ Naturally hydrophobic
- ▶ Low temperature range



GUR®: Broadest UHMW-PE Portfolio



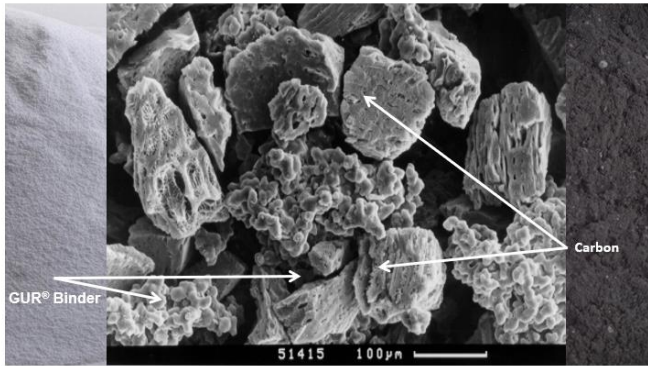
- ▶ GUR® UHMW-PE grades offer a broad range of particle sizes and molecular weights.
- ▶ Special pelletized grades support advanced melt processing techniques.

- ▶ Hydrophilic grades enhance compatibility with polar matrices.
- ▶ Eco-friendly ECO-B grades utilize bio-circular ethylene feedstock leading to significant CO₂ reduction.

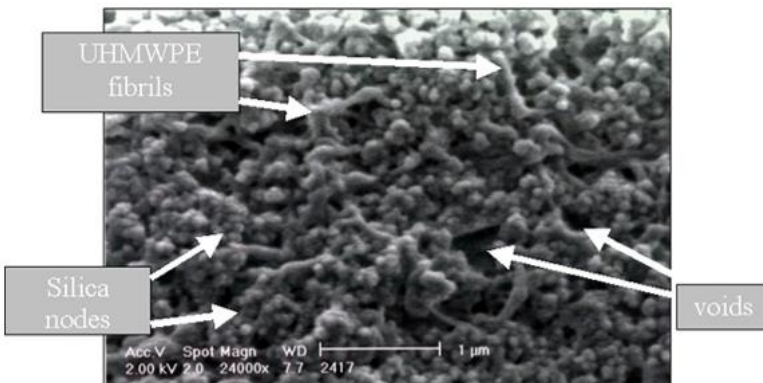
GUR[®] UHMW-PE as a Battery Dry Binder Material

GUR® UHMW-PE for Binder Applications

GUR® UHMW-PE is well known as a binder material e.g. in water filters and lead acid battery separators



Water filter with GUR® UHMW-PE binder



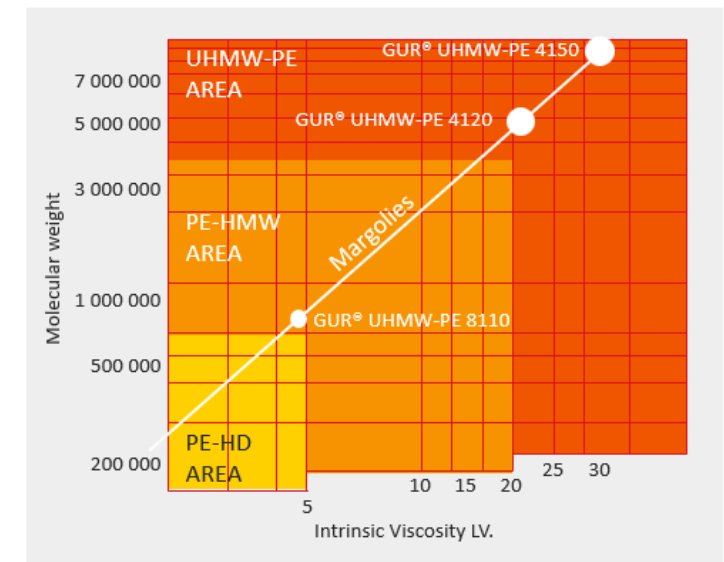
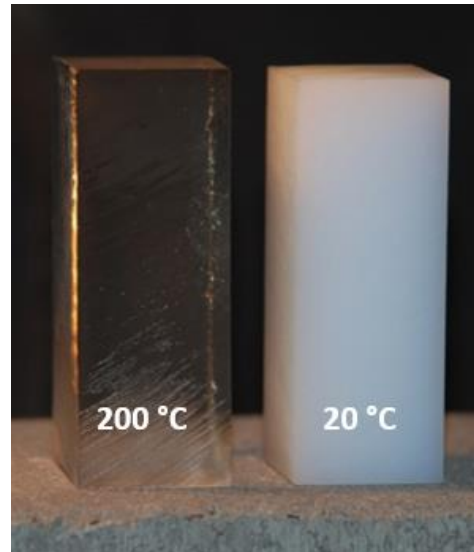
Lead acid battery separator with GUR® UHMW-PE binder

As material has no melt flow a porous structure is created via heating

Retains shape and size in molten state

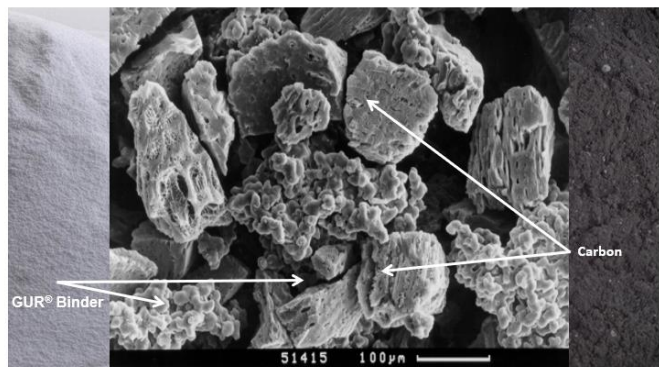
Binds only at contact points

Tunable performance with the choice of different GUR® UHMW-PE grades

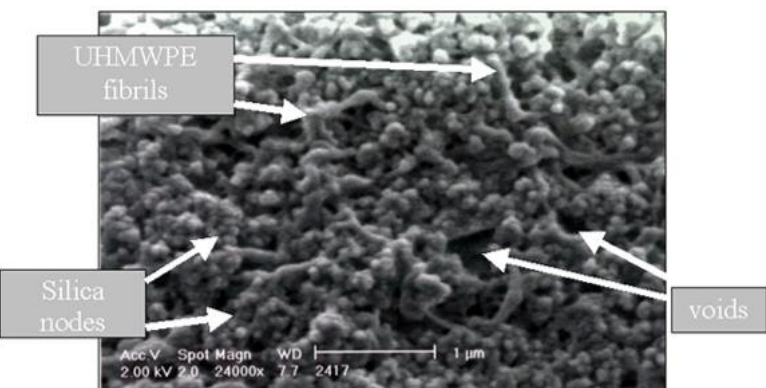


GUR® UHMW-PE for Binder Applications

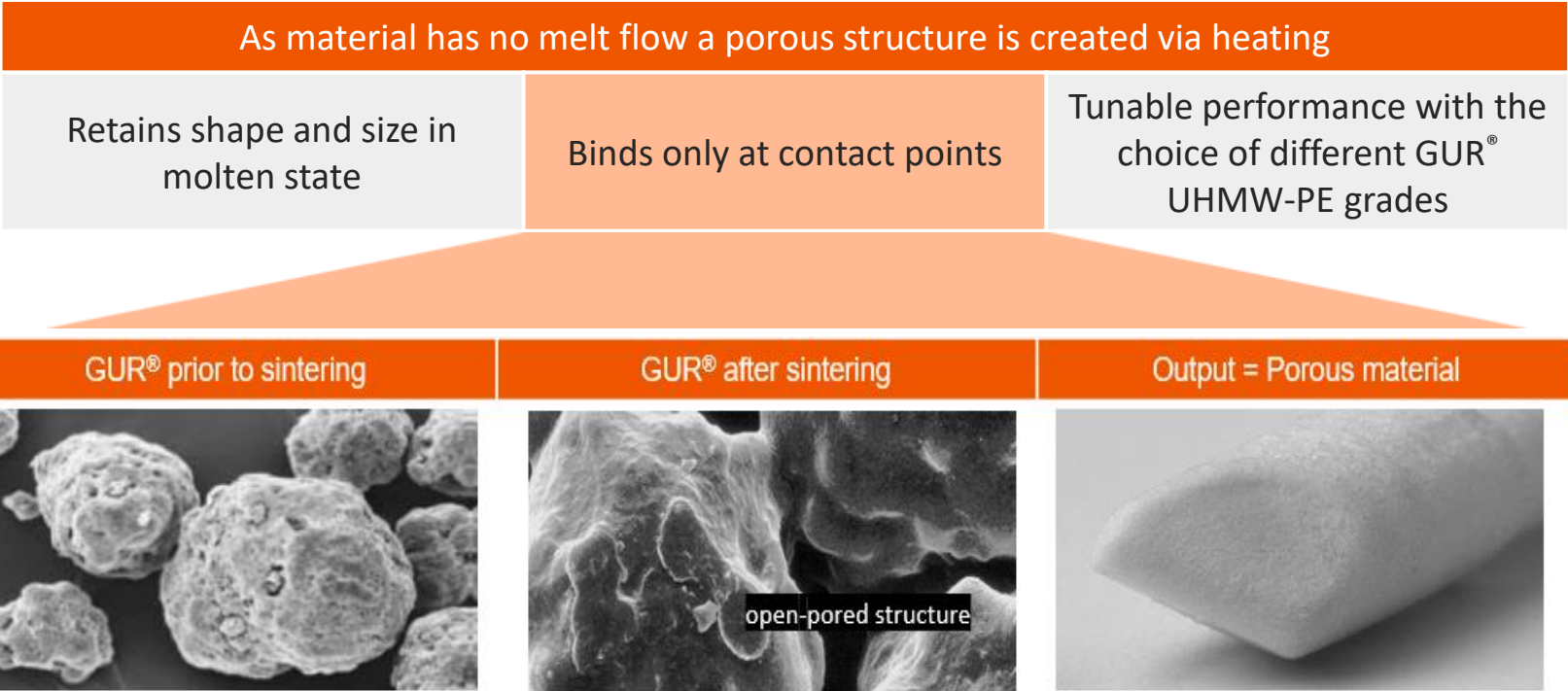
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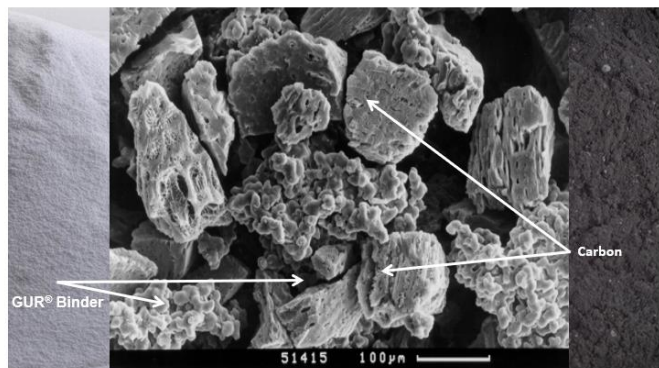


Lead acid battery separator with GUR® UHMW-PE binder

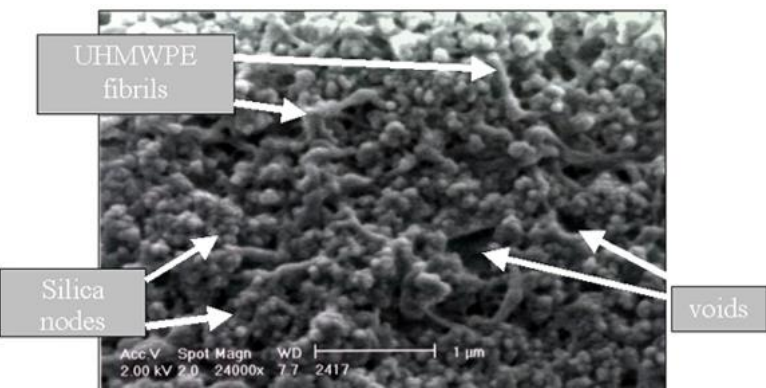


GUR® UHMW-PE for Binder Applications

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Water filter with GUR® UHMW-PE binder



Lead acid battery separator with GUR® UHMW-PE binder

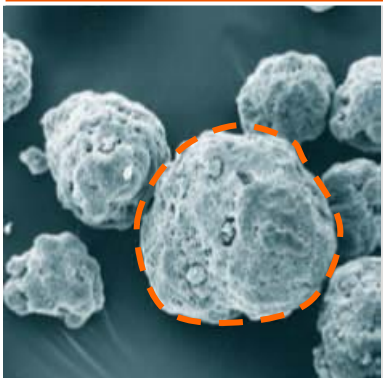
As material has no melt flow a porous structure is created via heating

Retains shape and size in molten state

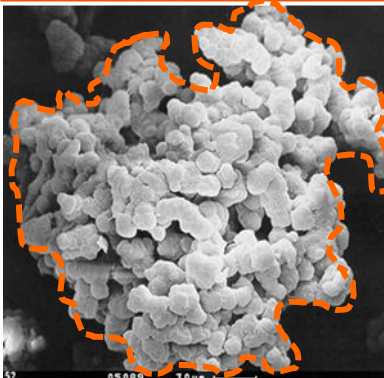
Binds only at contact points

Tunable performance with the choice of different GUR® UHMW-PE grades

GUR® UHMW-PE with high bulk density > 400 g/l



GUR® UHMW-PE with low bulk density > 230 g/l



GUR® UHMW-PE for Electrode Dry Binder Application

Electrode processing:



Step 1: Mixing

Linear velocity ~ 40 m/s; $t \sim 30$ min



Step 2: Extrusion

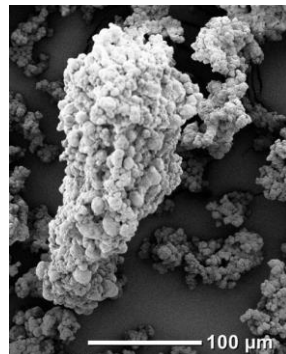
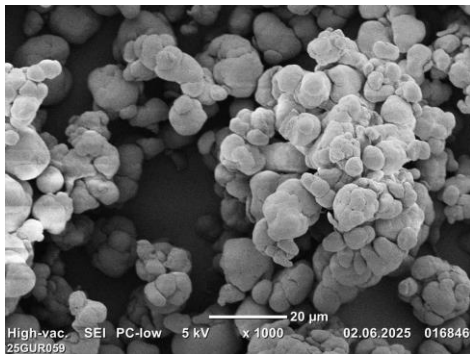
$T \sim 120^\circ\text{C}$; Speed: 30 to 60 RPM



Step 3: Calendering

$T \sim 120^\circ\text{C}$, gap: 800 to 100 μm

Developed GUR® UHMW-PE Popcorn Binder Products ($<15 \mu\text{m}$):



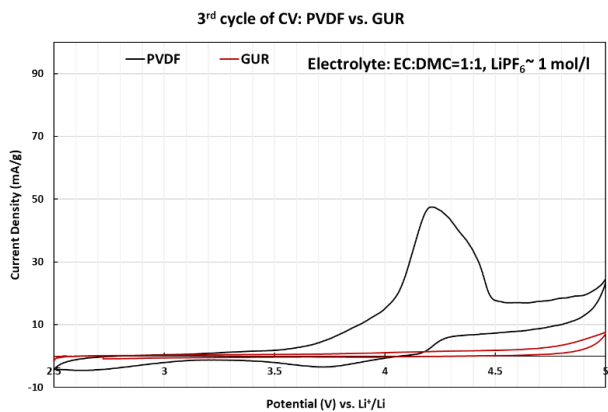
Mixing
Extrusion
Calendering



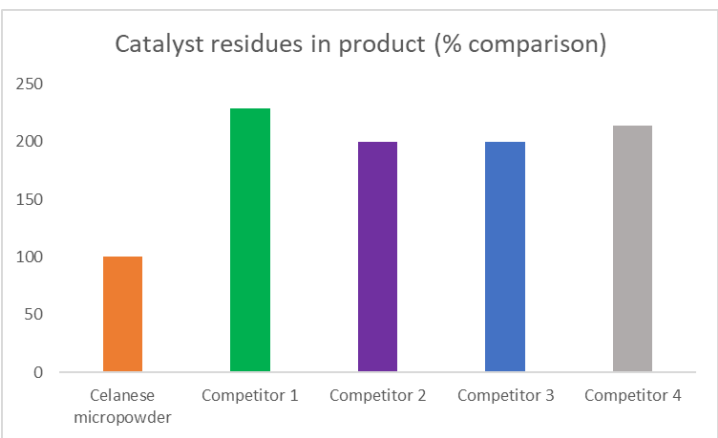
Crushed GUR® UHMW-PE
particles on electrode
surface:
Particle size: 1-3 μm

Combination of GUR® UHMW-PE popcorn technology and suitable processing conditions lead to GUR® UHMW-PE crushing providing higher binder efficiency

Value proposition: GUR® UHMW-PE for dry binder application



GUR® UHMW-PE is electrochemically stable in the Li-ion battery working window



GUR® UHMW-PE provides lowest metal/catalyst residues for highest battery safety

Resin and catalyst development:

- Catalyst synthesis
- Lab- and pilot-line scale polymerization

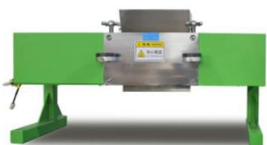


Resin characterization:

- Thermal, molecular weight, optical, chemical, rheology

DBE processing:

- Internal mixer and roll mill
- Collaboration with research institutes



Broad capabilities to support GUR® UHMW-PE technology development

Property	GUR® UHMW-PE	PTFE
PFAS-free	+	-
Carbon footprint [kg/kg product]	~2	>>10
Density [g/ml]	0.93	2.2
Electrochem. stability	+	-
Fibrillation	0	+

GUR® UHMW-PE is environmentally-friendly and does not contain any intentionally added PFAS

GUR® UHMW-PE Global Manufacturing Footprint



GUR® UHMW-PE has global manufacturing footprint (EU, Asia & USA)

Higher mechanical performance & temperature resistance in comparison to standard HDPE

Strong GUR® UHMW-PE R&D capability:

1. GUR® UHMW-PE development grade with low D50 of 15µm available per request.
2. Adjustable electrolyte affinity with hydrophilic GUR® UHMW-PE.

Key Takeaways on GUR® UHMWPE as a Battery Dry Binder

- ▶ GUR® UHMWPE is a white powder with a very *high melt viscosity*.
- ▶ GUR® UHMWPE is well known as a binder material e.g. for water filters and lead acid battery separators.
- ▶ GUR® UHMWPE is a very promising battery dry binder material utilizing a special popcorn morphology.
- ▶ Celanese is the inventor of GUR® UHMWPE, providing the broadest UHMW-PE portfolio with highest quality and global manufacturing footprint.
- ▶ GUR® UHMWPE is environmentally-friendly and does not contain any intentionally added PFAS.



Questions? Contact Us



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- ▶ Reach out for more information and support

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