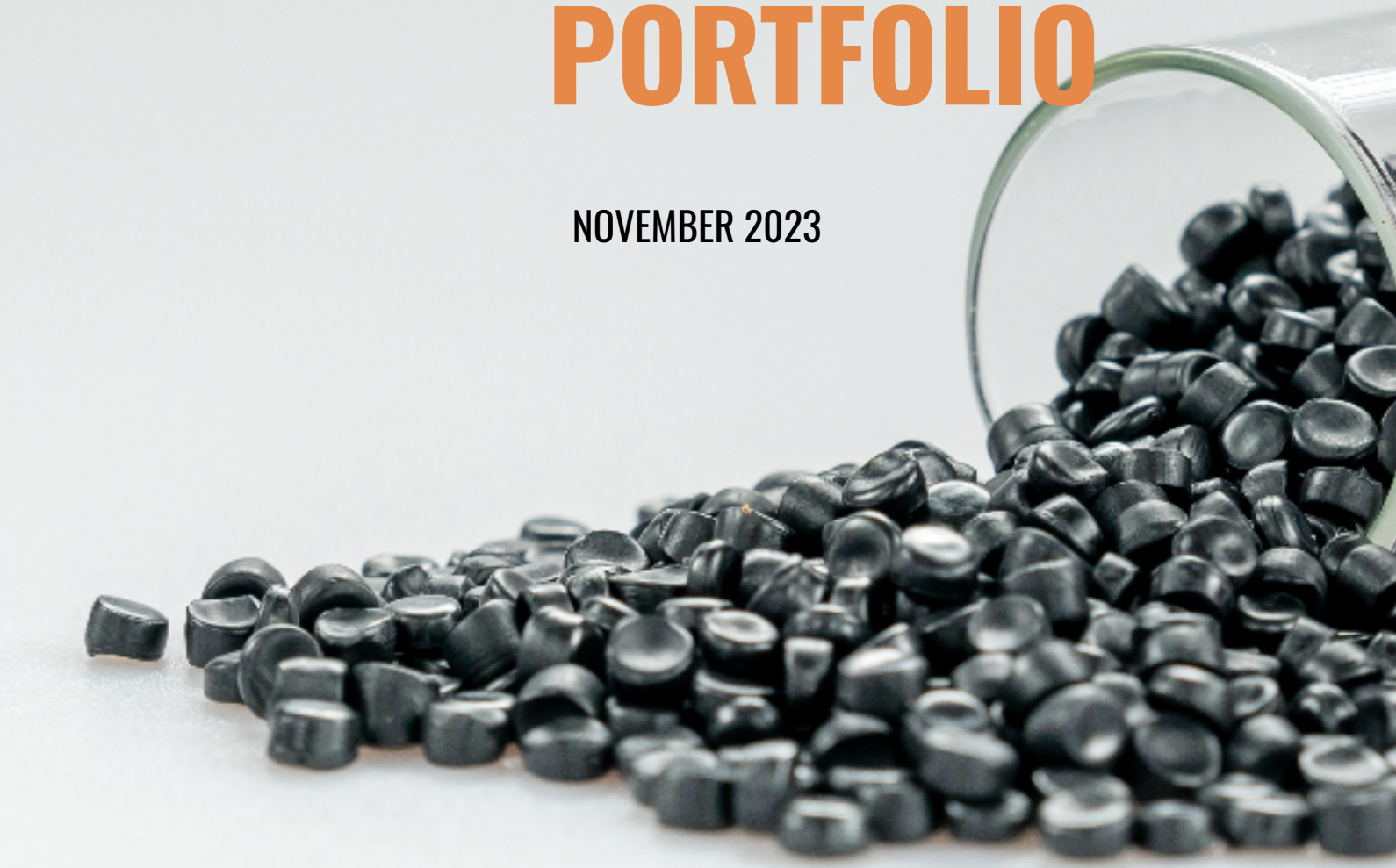
Versarien®

THERMOPLASTICS **PORTFOLIO**

NOVEMBER 2023



ABOUT VERSARIEN

Versarien plc (AIM: VRS) is an IP-led advanced engineering materials group that utilises proprietary technology to create innovative engineering solutions. Versarien holds more than 130 patents covering areas including the manufacture and use of graphene and related materials (GRMs) in diverse applications. We develop and manufacture advanced materials and products globally through a number of subsidiaries and have the widest portfolio of high-quality verified products.

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Want to know more? Get in touch today

Visit our website: www.versarien.com

Email us at: info@versarien.com

Write to us at: Units 1A-D
Longhope Business Park
Monmouth Road
Longhope
Gloucestershire
GL17 0QZ
United Kingdom

Call us on: +44 (0) 1594 887204

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THERMOPLASTICS

THERMOPLASTICS

A thermoplastic is a class of polymer that can be softened through heating and then processed using methods such as extrusion, injection moulding, thermoforming and blow moulding. Thermoplastics harden once cooled and do not show any changes in chemical property after being heated and cooled multiple times. In general, thermoplastics have a number of advantages and disadvantages:

Advantages:

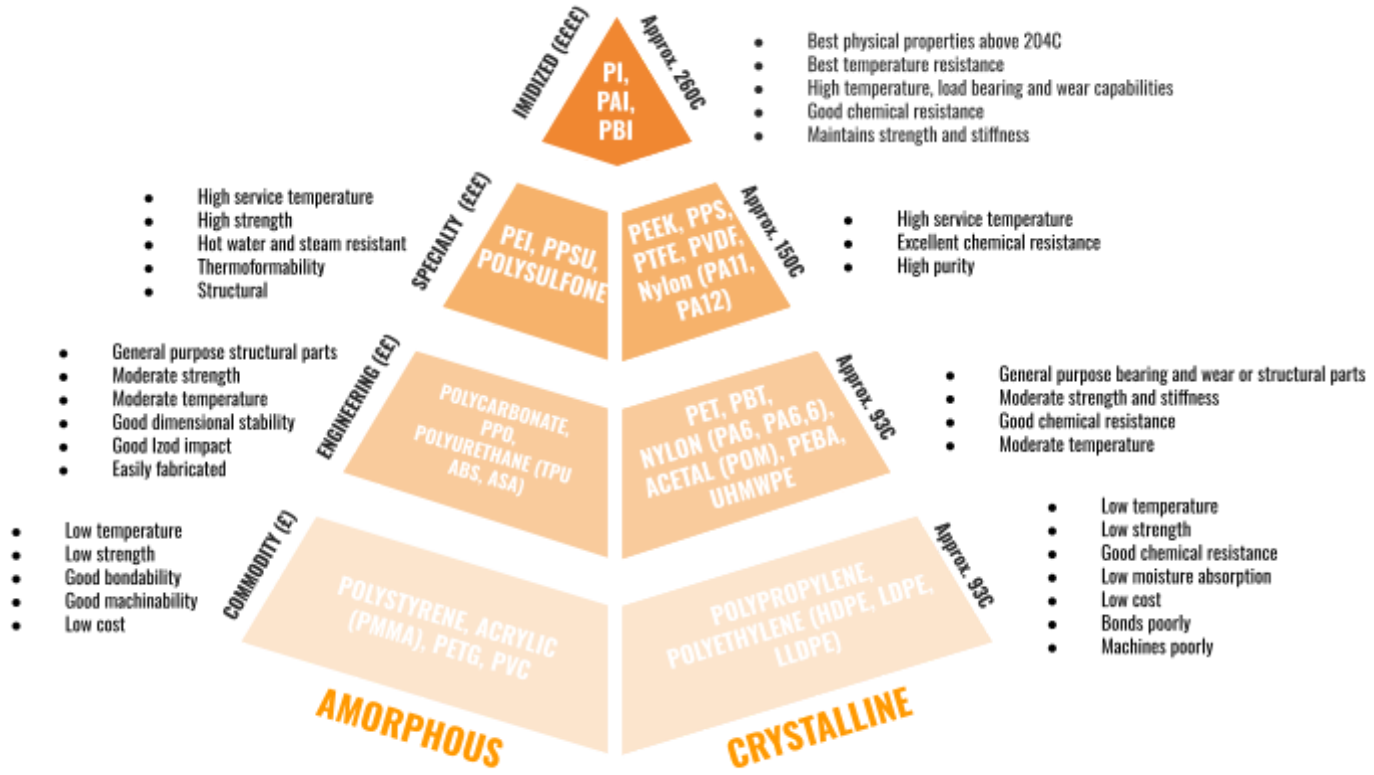
- Readily recyclable
- Wide range of mechanical properties
- Lightweight compared to metals
- Aesthetically-superior surface finish compared to thermosets
- Good chemical resistance
- Energy-efficient processing

Disadvantages:

- Due to their low melting point compared to metals, thermoplastics are inappropriate for use on some high temperature applications.
- Some thermoplastics are susceptible to creep when exposed to long-term stress loads.

Thermoplastic elastomers (TPEs) are copolymers or compounds that deliver thermoplastic and elastomeric properties. TPEs exhibit thermoplastic characteristics above their melt temperatures, which allow them to be shaped into fabricated articles. When used within their design temperature ranges, TPEs show elastomeric behaviour without cross-linking during fabrication. In addition, this process is reversible, meaning that products can be reprocessed and remoulded.

The plastics pyramid below gives a general overview of the types of polymer and their properties. Every application has unique material characteristic requirements for temperature, strength, cost and more. Before a thermoplastic polymer can be used it is normally mixed with additives, such as stabilisers, plasticisers, lubricants, flame retardants and colourants, to improve the polymer's functionality, stability or appearance. For example, stabilisers are added to reduce degradation due to sunlight or heat and plasticisers can be added to increase the mobility of amorphous chain segments, lowering the glass transition temperature and decreasing brittleness. Graphene and related nanomaterials are additives that offer a broad range of multi-functionality to thermoplastics. Versarien are experienced in the compounding of nanomaterials and other additives into thermoplastics to achieve the desired properties.



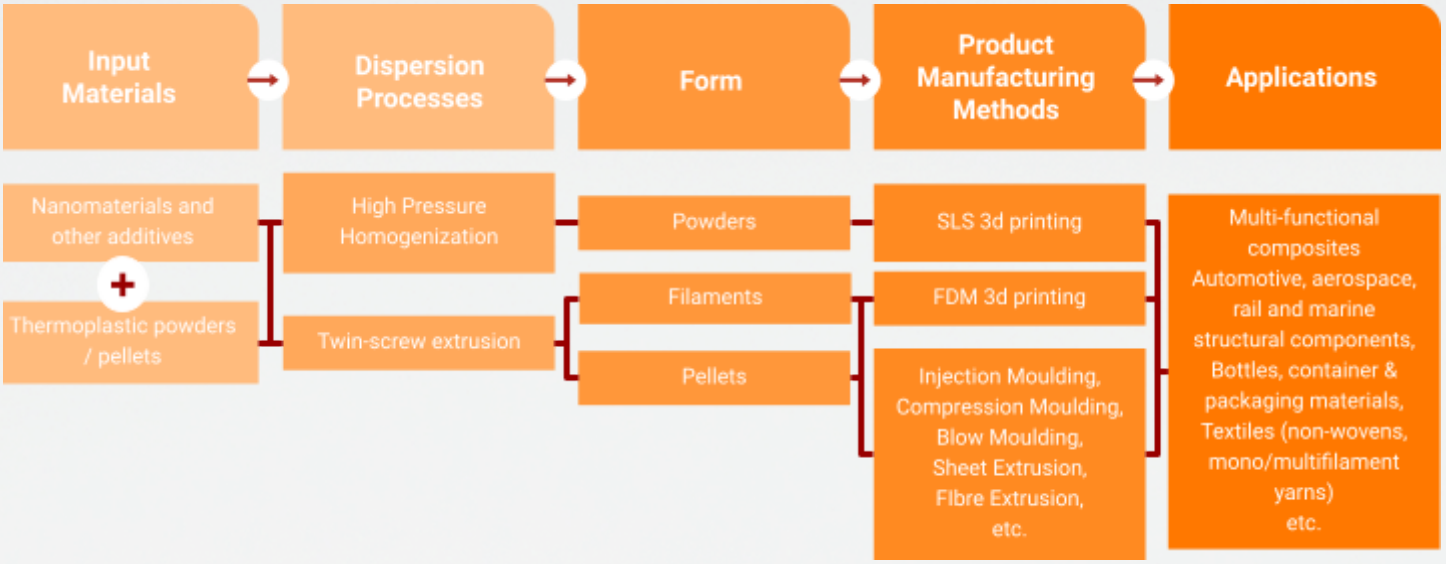
The plastics pyramid. Credit: https://divplast.com/plastics-material-selection

POLYMERS PORTFOLIO

Polygrene-Thermoplastics are produced by melt-processing Versarien's nanomaterials (e.g. Nanene™ and Hexotene™) along with other additives and virgin polymer pellets using processes such as twin-screw extrusion to manufacture compounds and masterbatches in pellet or filament form.

Versarien's materials testing either takes place through its R&D teams based at the Graphene Engineering Innovation Centre (GEIC), University of Manchester and at the Cambridge Graphene Centre (CGC), University of Cambridge or through Versarien funded researchers based at WMG, University of Warwick. A number of tests are also performed by independent test laboratories or performed entirely by our clients.

Versarien is here to help you select the right enhanced plastic for your application.



Process flow for the manufacture of Versarien's Polygrene™-Thermoplastic compounds/masterbatches and their downstream products

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POLYMERS PORTFOLIO

POLYGRENE SERIES	POLYMER TYPE
COMMODITY POLYMERS	
1100	High density polyethylene (HDPE)
ENGINEERING POLYMERS	
1200	Acrylonitrile butadiene styrene (ABS)
1205	Acrylonitrile styrene acrylate (ASA)
1215	Polyamide-6 (PA6)
1220	Polyamide-6,6 (PA66)
1230, 1231, 1232	Thermoplastic polyurethane (TPU) (ether-based)
1235, 1236, 1237	Polyether block amide (PEBA)
SPECIALTY POLYMERS	
1300, 1301, 1302	Ethylene copolymers
1305	Polyetherimide (PEI)
1315	Poly aryl ether ketones (PAEKs)

TERMINOLOGY EXAMPLES (POLYGRENE-XXXX-Y-Z)				
SERIES (XXXX)	-	**FILLER TYPE (Y) ***	-	**FILLER LOADING (Z)**
1100	-	**N2**	-	**30**
HDPE		*Nanene-002 (graphene)*		*30 wt.%*
1215	-	**HBN1**	-	**0.5**
PA6		*Hexagonal boron nitride*		*0.5 wt.%*
1237	-	**N2**	-	**0.1**
PEBA		*Nanene-002 (graphene)*		*0.1 wt.%*
1315	-	**N2**	-	**0.5**
PEEK		*Nanene-002 (graphene)*		*0.5 wt.%*

PRODUCT FAMILY	APPLICATION / USAGE
Polygrene-MF	Polygrene-MF1105 - polypropylene (PP) macrofibres for concrete reinforcement
Polygrene-3D	3D printing filaments
Polygrene-E	Electrically conductive compounds for applications such as EMI shielding
Polygrene-T	Thermally conductive compounds for applications such as thermal management

* See Nanomaterials Portfolio for filler technical datasheets: https://www.versarien.com/index.php/download_file/187/

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POLYMERS PORTFOLIO

POLYGRENE-1100 BLOW MOULDED BOTTLES

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POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polygrene-1100 Series

PRODUCT INFORMATION	
Polymer Type	High density polyethylene (HDPE)
Form	Pellets
Properties	HDPE has excellent impact strength, high strength to weight ratio, and outstanding chemical resistance.
Uses	Blow molding applications, bottles for consumer goods and food packaging

PRODUCT CHARACTERISTICS

NAME	TEST METHOD	UNIT	PRODUCT							
			HDPE	**N2-20/30**	**N2-0.1**	**N2-0.5**	**HBN1-30**	**HBN1-1.0**	**HBN2-30**	**HBN2-1.0**
GENERAL POLYMER PROPERTIES										
Colour	Visual		Translucent	Black	Black	Black	White	White	White	White
Density	ISO 1183	g/cm^3	-	-	-	-	-	-	-	-
RHEOLOGICAL PROPERTIES										
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-	-	-	-	-	-
THERMAL PROPERTIES										
Melting Temperature	ISO 11357-3	°C	134	-	137	-	-	-	-	-
Glass Transition Temperature	ISO 11357-2		-	-	-	-	-	-	-	-
MECHANICAL PROPERTIES										
Tensile Modulus	ISO 527-1,-2 5 mm/min	MPa	1380	-	1530	1630	-	1690	-	1680
Yield Stress		MPa	35.4	-	44.2	48.4	-	35.3	-	33.8
Yield strain		%	11.8	-	14.4	11.1	-	10.4	-	10.5
Stress at Break		MPa	-	-	-	-	-	35.5	-	33.8
Strain at Break		%	55	-	55	52	-	48	-	45

POLYGRENE-1205 3D PRINTED ARCH

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POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polygrene-1200 Series

PRODUCT INFORMATION	
Polymer Type	ABS
Form	Pellets
Properties	High rigidity, toughness and dimensional stability, good impact and mechanical properties.
Uses	Enclosures for electrical devices, protective headgear, joinery, small kitchen appliances, automotive parts

PRODUCT CHARACTERISTICS					
NAME	**TEST METHOD**	**UNIT**	**PRODUCT**		
			ABS	**N2-10/20**	**N2-0.1**
GENERAL POLYMER PROPERTIES					
Colour	Visual		White	Black	Black
Density	ISO 1183	g/cm^3	1.04	-	-
RHEOLOGICAL PROPERTIES					
Melt Mass-Flow Rate	ISO 1133	g/10 min	12	-	-
THERMAL PROPERTIES					
Melting Temperature	ISO 11357-3	°C	-	-	-
Glass Transition Temperature	ISO 11357-2		-	-	-
MECHANICAL PROPERTIES					
Tensile Modulus	ISO 527-1,-2 5 mm/min	MPa	2240	-	2530
Yield Stress		MPa	44.4	-	61.4
Yield strain		%	2.5	-	3.1
Stress at Break		MPa	-	-	-
Strain at Break		%	32	-	39

Polygrene-1205 Series

PRODUCT INFORMATION	
Polymer Type	ASA
Form	Pellets
Properties	High rigidity and dimensional stability, good impact and mechanical properties.UV and weather resistant.
Uses	Furniture, fittings and cosmetic packaging, automotive body parts.

PRODUCT CHARACTERISTICS					
NAME	**TEST METHOD**	**UNIT**	**PRODUCT**		
			ASA	**N2-0.1**	**N2/HBN1-10/20**
GENERAL POLYMER PROPERTIES					
Colour	Visual		White	Black	Black/White
Density	ISO 1183	g/cm^3	-	-	-
RHEOLOGICAL PROPERTIES					
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-
THERMAL PROPERTIES					
Melting Temperature	ISO 11357-3	°C	-	-	-
Glass Transition Temperature	ISO 11357-2		-	-	-
MECHANICAL PROPERTIES					
Tensile Modulus	ISO 527-1,-2 5 mm/min	MPa	2290	2340	-
Yield Stress		MPa	56.2	61.7	-
Yield strain		%	3.3	3.6	-
Stress at Break		MPa	-	-	-
Strain at Break		%	37	44	-

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POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polygrene-1215 Series

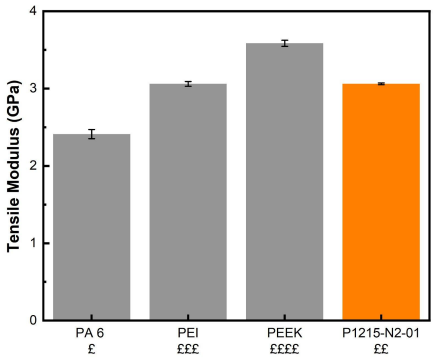
PRODUCT INFORMATION

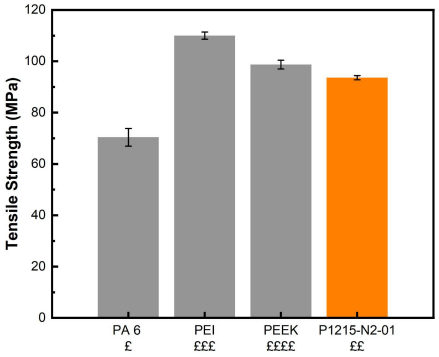
Polymer Type	Polyamide-6 (PA6, Nylon-6)
Form	Pellets
Properties	Outstanding mechanical properties, outstanding wear, abrasion, chemical and oil resistance, long term heat resistance and almost all grades are self-extinguishing, excellent aesthetics.
Uses	Gears, bearings, automotive body parts, electric and electronic components, textiles, sport and leisure goods.

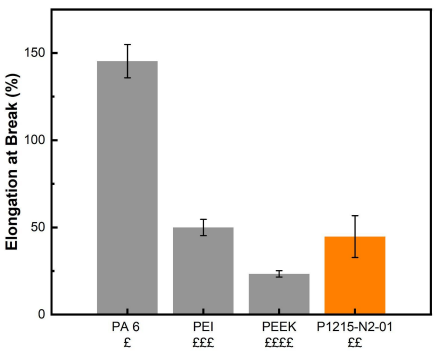
PRODUCT CHARACTERISTICS

NAME	TEST METHOD	UNIT	PRODUCT				
			PA6	**N2-10/20**	**N2-0.1**	**HBN1-10/20**	**HBN1-0.5**
GENERAL POLYMER PROPERTIES							
Colour	Visual		Translucent	Black	Black	White	White
Density	ISO 1183	g/cm^3	-		-	-	-
RHEOLOGICAL PROPERTIES							
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-	-	-
THERMAL PROPERTIES							
Melting Temperature	ISO 11357-3	°C	224	-		-	-
Glass Transition Temperature	ISO 11357-2		-	-	-	-	-
MECHANICAL PROPERTIES							
Tensile Modulus	ISO 527-1,-2 5 mm/min	MPa	2410	-	3060	-	3150
Yield Stress		MPa	70.4	-	93.6	-	86.7
Yield strain		%	3.9	-	4.0	-	3.8
Stress at Break		MPa	-	-	-	-	-
Strain at Break		%	145	-	45	-	20

TEST DATA







AS STIFF AS PEI **AS STRONG AS PEEK** **SIMILAR ELONGATION**

- LOWER PRICE, LOWER TEMPERATURE PROCESSING -

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POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polygrene-1220 Series

PRODUCT INFORMATION	
Polymer Type	Polyamide-6,6 (PA66, Nylon-6,6)
Form	Pellets
Properties	Excellent mechanical properties, outstanding wear, abrasion, chemical and oil resistance, long term high heat resistance, excellent aesthetics.
Uses	Textiles, electric and electronic components (complex parts), automotive parts exposed to high temperatures.

PRODUCT CHARACTERISTICS

NAME	TEST METHOD	UNIT	PRODUCT					
			PA66	**N2-10/20**	**N2-0.1**	**N2-0.5**	**HBN1-10/20**	**HBN1-0.5**
GENERAL POLYMER PROPERTIES								
Colour	Visual		Off White		Black	Black	White	White
Density	ISO 1183	g/cm^3	1.09		-	-	-	-
RHEOLOGICAL PROPERTIES								
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-	-	-	-
THERMAL PROPERTIES								
Melting Temperature	ISO 11357-3	°C	263	-	-		-	-
Glass Transition Temperature	ISO 11357-2		-	-	-	-	-	-
MECHANICAL PROPERTIES								
Tensile Modulus	ISO 527-1,-2 5 mm/min	MPa	2190	-	2330	2440	-	2340
Yield Stress		MPa	57.3	-	69	69.7	-	68.1
Yield strain		%	11	-	10.8	8.7	-	10.2
Stress at Break		MPa	-	-	-	-	-	-
Strain at Break		%	31	-	33	23	-	28

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POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polygrene-1230 Series

PRODUCT INFORMATION	
Polymer Type	Thermoplastic polyurethane (TPU), ether based
Form	Pellets
Properties	Resistance to hydrolysis and good flexibility at low temperature, good wear performance
Uses	Cable sheathing, plugs and terminations, hoses, damping elements.
Shore D Hardness	~ 36

PRODUCT CHARACTERISTICS

NAME	TEST METHOD	UNIT	PRODUCT		
			TPU	**N2-10/20**	**N2-0.1**
GENERAL POLYMER PROPERTIES					
Colour	Visual		Translucent	Black	Black
Density	ISO 1183	g/cm^3	1.12	-	-
RHEOLOGICAL PROPERTIES					
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-
THERMAL PROPERTIES					
Melting Temperature	ISO 11357-3	°C	180		181
Glass Transition Temperature	ISO 11357-2		-	-	-
MECHANICAL PROPERTIES					
Tensile Modulus	ISO 527-1,-2 50 mm/min	MPa	19.6	-	24.6
Yield Stress		MPa	-	-	-
Yield strain		%	-	-	-
Stress at Break		MPa	25.8	-	28.3
Strain at Break		%	544	-	545
Shore D Hardness	ISO 868	-	36	-	36

Polygrene-1231 Series

PRODUCT INFORMATION	
Polymer Type	Thermoplastic polyurethane (TPU), ether based
Form	Pellets
Properties	Hydrolysis resistance and good flexibility at low temperature, good wear and abrasion performance
Uses	Ear tags, hoses, roller tyres for conveyor systems and shopping trolleys
Shore D Hardness	~ 54

PRODUCT CHARACTERISTICS

NAME	TEST METHOD	UNIT	PRODUCT		
			TPU	**N2-10/20**	**N1-0.1**
GENERAL POLYMER PROPERTIES					
Colour	Visual		White	Black	Black
Density	ISO 1183	g/cm^3	1.12	-	-
RHEOLOGICAL PROPERTIES					
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-
THERMAL PROPERTIES					
Melting Temperature	ISO 11357-3	°C	210		210
Glass Transition Temperature	ISO 11357-2		-	-	-
MECHANICAL PROPERTIES					
Tensile Modulus	ISO 527-1,-2 50 mm/min	MPa	232.5	-	244
Yield Stress		MPa	-	-	-
Yield strain		%	-	-	-
Stress at Break		MPa	54.6	-	54
Strain at Break		%	534	-	524
Shore D Hardness	ISO 868	-	54	-	54

POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polygrene-1232 Series

PRODUCT INFORMATION	
Polymer Type	Thermoplastic polyurethane (TPU), ether based
Form	Pellets
Properties	Hydrolysis resistance and good flexibility at low temperature, good wear and abrasion performance
Uses	Ski binding elements, ski surface films, spike studs in sport shoes.
Shore D Hardness	~ 74

PRODUCT CHARACTERISTICS					
NAME	TEST METHOD	UNIT	PRODUCT		
			TPU	**N1-10/20**	**N1-0.3**
GENERAL POLYMER PROPERTIES					
Colour	Visual		Translucent	Black	Black
Density	ISO 1183	g/cm^3	1.12	-	-
RHEOLOGICAL PROPERTIES					
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-
THERMAL PROPERTIES					
Melting Temperature	ISO 11357-3	°C	220		220
Glass Transition Temperature	ISO 11357-2		-	-	-
MECHANICAL PROPERTIES					
Tensile Modulus	ISO 527-1,-2 10 mm/min	MPa	960	-	1100
Yield Stress		MPa	-	-	-
Yield strain		%	-	-	-
Stress at Break		MPa	74.8	-	59.3
Strain at Break		%	261	-	235
Shore D Hardness	ISO 868	-	74	-	74

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POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polygrene-1235 Series

PRODUCT INFORMATION	
Polymer Type	Poly ether block amide (PEBA)
Form	Pellets
Properties	Biocompatible, low hysteresis, lightweight, outstanding impact resistance even at low temperatures
Uses	Flexible parts, power transmission belts
Shore D Hardness	~ 35

PRODUCT CHARACTERISTICS

NAME	TEST METHOD	UNIT	PRODUCT		
			PEBA	**N2-10/20**	**N2-0.5**
GENERAL POLYMER PROPERTIES					
Colour	Visual		Translucent	Black	Black
Density	ISO 1183	g/cm^3	1.01	-	-
RHEOLOGICAL PROPERTIES					
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-
THERMAL PROPERTIES					
Melting Temperature	ISO 11357-3	°C	172		
Glass Transition Temperature	ISO 11357-2		-	-	-
MECHANICAL PROPERTIES					
Tensile Modulus	ISO 527-1,-2 50 mm/min	MPa	22.7	-	26.1
Yield Stress		MPa	-	-	-
Yield strain		%	-	-	-
Stress at Break		MPa	21.5	-	22.4
Strain at Break		%	1023	-	1100
Shore D Hardness	ISO 868	-	35	-	35

Polygrene-1236 Series

PRODUCT INFORMATION	
Polymer Type	Poly ether block amide (PEBA)
Form	Pellets
Properties	Biocompatible, low hysteresis, lightweight, outstanding impact resistance even at low temperatures
Uses	Flexible parts, power transmission belts
Shore D Hardness	~ 45

PRODUCT CHARACTERISTICS

NAME	TEST METHOD	UNIT	PRODUCT		
			PEBA	**N2-10/20**	**N2-0.1**
GENERAL POLYMER PROPERTIES					
Colour	Visual		Translucent	Black	Black
Density	ISO 1183	g/cm^3	1.01	-	-
RHEOLOGICAL PROPERTIES					
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-
THERMAL PROPERTIES					
Melting Temperature	ISO 11357-3	°C	172		
Glass Transition Temperature	ISO 11357-2		-	-	-
MECHANICAL PROPERTIES					
Tensile Modulus	ISO 527-1,-2 50 mm/min	MPa	98.2	-	103
Yield Stress		MPa	-	-	-
Yield strain		%	-	-	-
Stress at Break		MPa	29.2	-	29.8
Strain at Break		%	880	-	890
Shore D Hardness	ISO 868	-	45	-	45

Polygrene-1237 Series

PRODUCT INFORMATION

POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polymer Type	Poly ether block amide (PEBA)
Form	Pellets
Properties	Biocompatible, low hysteresis, lightweight, outstanding impact resistance even at low temperatures
Uses	Sports equipment, footwear, medical tubing
Shore D Hardness	~ 70

PRODUCT CHARACTERISTICS

NAME	TEST METHOD	UNIT	PRODUCT				
			PEBA	**N2-10/20**	**N2-0.1**	**HBN1-10/20**	**HBN1-0.5**
GENERAL POLYMER PROPERTIES							
Colour	Visual		Translucent	Black	Black	White	White
Density	ISO 1183	g/cm^3	1.01	-	-	-	-
RHEOLOGICAL PROPERTIES							
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-	-	-
THERMAL PROPERTIES							
Melting Temperature	ISO 11357-3	°C	172	-	-	-	-
Glass Transition Temperature	ISO 11357-2		-	-	-	-	-
MECHANICAL PROPERTIES							
Tensile	ISO 527-1,-2 10 mm/min	MPa	642	-	720	-	680
Yield Stress		MPa	30.2	-	37.8	-	33.1
Yield strain		%	16.2	-	16.5	-	15.5
Stress at Break		MPa	43.3	-	51.9	-	45.9
Strain at Break		%	219	-	257	-	245
Shore D Hardness	ISO 868	-	70	-	70	-	70

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POLYMERS PORTFOLIO

POLYGRENE-1305 & POLYGRENE-1315 TENSILE TEST SPECIMENS

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POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polygrene-1300, 1301, 1302 Series

PRODUCT INFORMATION	
Polymer Type	Ethylene copolymers(Vinyl acetate, acrylate and others)
Form	Pellets
Properties	EVA[1]: Increases toughness and flexibility, chemical and microbial resistant. EMA[2]: Imparts elastomeric properties, excellent aging, corrosion, and weather-resistant properties. EBAGMA[3]: Asphalt modifier, good metal adhesion, corrosion resistant.
Uses	Non-migrating PVC plasticiser (EVA), compatibilizerPlasticiser for different matrices (PE, PC, polyesters) (EMA), mitigating agent for cathodic disbondment, asphalt modifier, compatibilizer (EBAGMA).

PRODUCT CHARACTERISTICS

NAME	TEST METHOD	UNIT	PRODUCT			
			EVA	**EMA**	**EBAGMA**	**N2-10/20/30/40**
GENERAL POLYMER PROPERTIES						
Colour	Visual		Translucent	Translucent	Translucent	Black
Density	ISO 1183	g/cm^3	1	0.95	0.84	-
RHEOLOGICAL PROPERTIES						
Melt Mass-Flow Rate	ISO 1133	g/10 min	35	3	8	-
THERMAL PROPERTIES						
Melting Temperature	ISO 11357-3	°C	66	85	72	-
Glass Transition Temperature	ISO 11357-2		-	-	-	-
MECHANICAL PROPERTIES						
Tensile Modulus	ISO 527-1,-2 - mm/min	MPa	-	-	-	-
Yield Stress		MPa	-	-	-	-
Yield strain		%	-	-	-	-
Stress at Break		MPa	5.9	-	-	-
Strain at Break		%	950	-	-	-
Shore A Hardness	ISO 868	-	70	-	-	-

[1] EVA: Ethylene vinyl acetate copolymer
[2] EMA: Ethylene methyl acrylate copolymer
[3] EBAGMA: Ethylene butyl acrylate glycidyl methyl acrylate terpolymer

POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polygrene-1305 Series

PRODUCT INFORMATION	
Polymer Type	Polyetherimide (PEI)
Form	Pellets
Properties	High heat resistance, stiffness, impact strength, transparency, high mechanical strength, good electrical properties, high flame resistance, low smoke generation, and chemical resistance. Autoclavable.
Uses	Automotive (Transmission components, fuses, gears, bearings), electrical motor parts, aircraft components for weight reduction in place of metal parts (metal replacement)

PRODUCT CHARACTERISTICS

NAME	TEST METHOD	UNIT	PRODUCT		
			PEI	**N2-10/20**	**N2-0.5**
GENERAL POLYMER PROPERTIES					
Colour	Visual		Amber	Black	Black
Density	ISO 1183	g/cm^3	1.26	-	-
RHEOLOGICAL PROPERTIES					
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-
THERMAL PROPERTIES					
Melting Temperature	ISO 11357-3	°C	-		
Glass Transition Temperature	ISO 11357-2		213	-	-
MECHANICAL PROPERTIES					
Tensile Modulus	ISO 527-1,-2 5 mm/min	MPa	3060	-	3210
Yield Stress		MPa	110	-	115
Yield strain		%	5.9	-	5.8
Stress at Break		MPa	-	-	-
Strain at Break		%	50	-	13
Shore D Hardness	ISO 868	-	-	-	-

Polygrene-1315 Series

PRODUCT INFORMATION	
Polymer Type	Poly ether ether ketone (PEEK)
Form	Pellets
Properties	Excellent mechanical properties even at high temperatures (up to 250°C), abrasion Resistance, chemical Resistance, High Ductility and elongation, hydrolysis resistance and autoclavable.
Uses	Aerospace (metal replacements), medical implants and equipment, dental implants, or processing equipment

PRODUCT CHARACTERISTICS

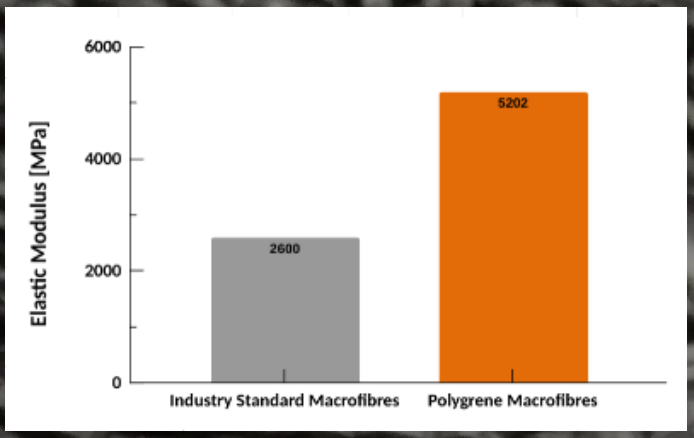
NAME	TEST METHOD	UNIT	PRODUCT		
			PEEK	**N2-10/20**	**N2-0.5**
GENERAL POLYMER PROPERTIES					
Colour	Visual		Light brown	Black	Black
Density	ISO 1183	g/cm^3	-	-	-
RHEOLOGICAL PROPERTIES					
Melt Mass-Flow Rate	ISO 1133	g/10 min	-	-	-
THERMAL PROPERTIES					
Melting Temperature	ISO 11357-3	°C	345		
Glass Transition Temperature	ISO 11357-2		-	-	-
MECHANICAL PROPERTIES					
Tensile Modulus	ISO 527-1,-2 5 mm/min	MPa	3580	-	3670
Yield Stress		MPa	98.7	-	103
Yield strain		%	4.6	-	4.6
Stress at Break		MPa	-	-	-
Strain at Break		%	23.3	-	53.3
Shore D Hardness	ISO 868	-	-	-	-

POLYGRENE
GRAPHENE ENHANCED POLYMERS

Polygrene-MF

Polypropylene (PP) is a thermoplastic used in a number of construction applications (geopolymer mesh, micro/macrofibres).

Macrofibres are generally used to minimise and/or eliminate both plastic and drying shrinkage cracking. They can be used to replace rebar and welded wire reinforcement and provide equal or better performance when the proper dosage is used. Macrofibres provide all the benefits of microfibres, in addition to increased durability, flexural toughness, and resistance to impact and abrasion. Versarien have developed graphene enhanced PP macrofibres that are superior to standard virgin PP macrofibers with 100% higher elastic modulus (stiffness).

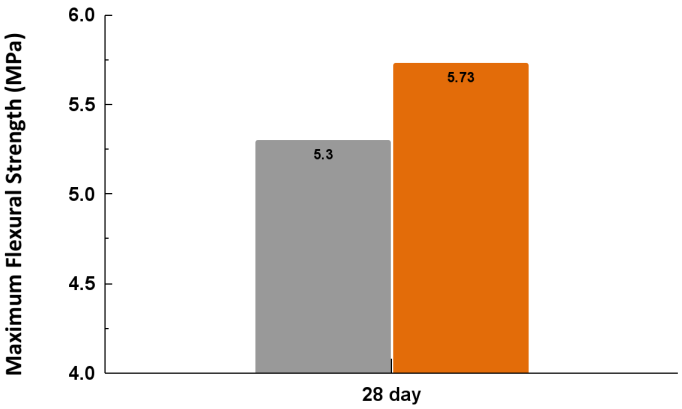


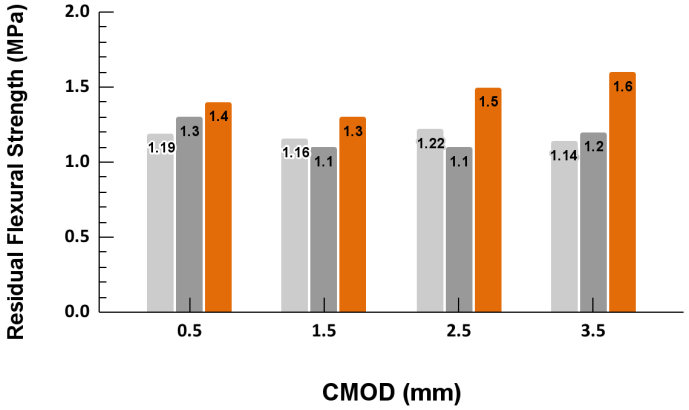
The benefits of **Polygrene-MF** includes:

- Increased flexural strengths
- Improved tensile properties of concrete
- Increased durability
- Reduced CO_2 and cost (less material, removal of steel rebar)
- Reduced material (thinner slab, less cover, reduced reinforcement)
-)

CONCRETE TEST DATA *Independent testing performed by SOCOTEC UK Limited (UKAS accredited)*

Concrete is relatively weak in tension and often requires some form of reinforcement to cope with tensile forces. Here, 3 kg/m^3 dosage of Polygrene-MF were added. Beams were tested against BS EN 14889-2 Fibres for concrete - Polymer fibres.





Industry Standard PP Macrofibre Control Concrete CEM I Control Mixes
Polygrene-MF reinforced CEM I Mix

Limit Of Proportionality (LOP) (with crack induced test piece)

Crack Mouth Opening Displacement (CMOD)

Polygrene-PP macrofibres outperform industry standard PP macrofibre reinforced concretes by +30% at the same dosage

Get in touch today to discuss your requirements

info@versarien.co.uk

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POLYGRENE
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Polygrene-3D

PRODUCT INFORMATION

Form	Available in 1.75mm and 2.85mm diameter filament spools to suit most printers.
Description	High performance materials for 3D printing technologies. Versarien's graphene enhanced 3d printer filaments have been developed for demanding applications requiring higher performance over standard filaments. Formulated using Versarien's proprietary nanomaterials and premium polymers.
Uses	Suitable for most commercially available FDM/FFF 3D printers with a heated print bed and adjustable temperature settings.

Increases in tensile modulus

Increases in tensile strength

Increases in elongation at break

Faster printing

1.75 / 2.85 mm filaments

Get in touch today to discuss your requirements

info@versarien.co.uk

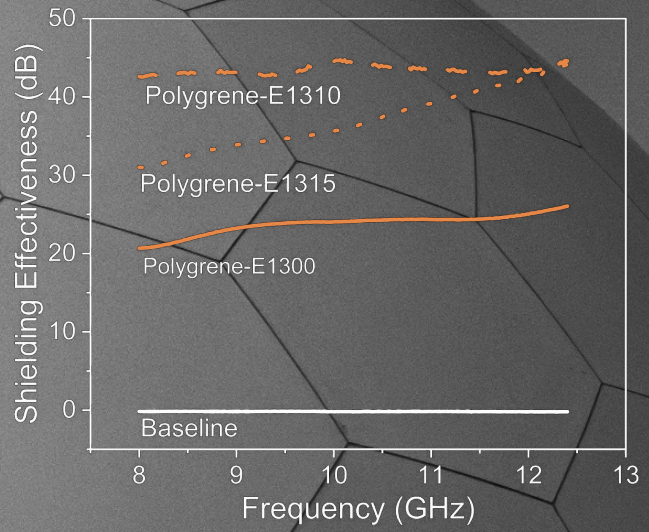
Versarien®

POLYGRENE
GRAPHENE ENHANCED POLYMERS

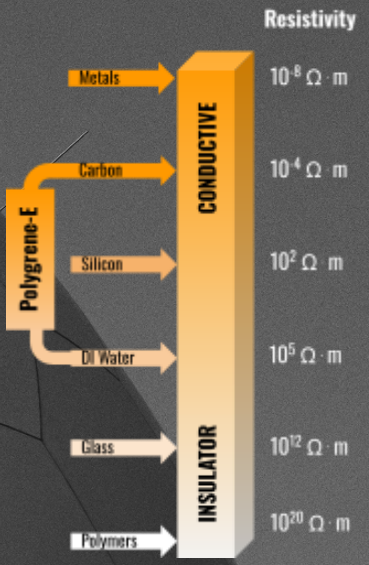
Polygrene-E

PRODUCT INFORMATION

Form	Pellets
Description	Electrically conductive formulations designed to block and /or absorb electromagnetic signals to prevent interferences avoiding disturbances or data loss in communication systems.
Uses	Consumer electronics, communications, aerospace, automotive, healthcare and defense.



X-band EMI Shielding Performance



EMI Shielding: Electromagnetic interference (EMI) shielding refers to the reflection and/or adsorption of electromagnetic radiation by a material, which thereby acts as a shield against the penetration of the radiation through the shield.

Static Dissipative: Materials that are able to prevent or limit triboelectric charging, limiting the risks of electric discharge.

Get in touch today to discuss your requirements
info@versarien.co.uk

Versarien

ACCREDITATIONS & COMPLIANCE

WITH THANKS TO OUR PARTNERS

ACADEMIC PARTNERS

GRANT FUNDING ORGANISATIONS

Versarien®

Versarien
Units 1A-1D
Longhope Business Park
Monmouth Road
Longhope
Gloucestershire
GL17 0QZ

www.versarien.com