COMPOSITE REINFORCEMENT TECHNOLOGIES

CUSTOMIZED FABRIC & PREPREG SOLUTIONS

KORDSA

THE REINFORCER

Discover how Kordsa develops its innovative and unique intermediate products and applications in composite reinforcement for a variety of industries.

We Reinforce Life

Kordsa, the reinforcer of 1 out of every 3 automobile tires manufactured globally and 2 out of every 3 aircraft tires produced worldwide, operates in tire reinforcement, construction reinforcement and composite technologies. Positioned as “The Reinforcer” with its innovative value-added technologies and expertise on reinforcement technologies, Kordsa has approximately 4,500 employees in 11 facilities throughout 4 continents.

In tire reinforcement technologies, Kordsa contributes to the manufacturing of environmentally friendly tires that reduce fuel use and sustain better grip. Kordsa develops composite technologies for aerospace and automotive industries to reduce fuel consumption and carbon emission. Thanks to its durable and practical reinforcement solutions in the construction industry, Kordsa continues to touch every aspect of life.

Composite Technologies

Kordsa continues to strengthen its name “The Reinforcer” in composite industry with new products. Main focus is to weave high-strength composite reinforcements with carbon, aramid, and glass, develop resin formulations, produce prepregs and develop applications for a variety of industries especially automotive, aerospace, marine, sports & leisure industries. In an effort to build a strong collaboration with its customers and meet customer needs, Kordsa offers design, analysis, material library and prototype production services while developing prepreg, fabric, and resin products.

In parallel with its strategy to increase its global market share and expand the product range, Kordsa have acquired Fabric Development Inc. (FDI) Textile Products Inc. (TPI) and Advanced Honeycomb Technologies Corporation (AHT), which provide advanced composite materials to the commercial aviation and aerospace industry in the US.

Composite Technologies Center of Excellence

Composite Technologies Center of Excellence, a technology hub driven by collaborative research and production, was conjointly established by Kordsa and Sabancı University in 2016. At the Composite Center, all processes including R&D, applied research, technology development, product development, prototype production, entrepreneurship and production are executed under the same roof. Thanks to this collaborative ecosystem, Kordsa offers tailor-made services to its customers by involving the stakeholders in all stages of research and development, from basic research to the production of a prototype and finally, to mass production.

Kordsa’s manufacturing facility at Composite Technologies Center of Excellence received BS EN ISO 9001:2015 ve EN 9100:2016 (AS9100D) certification, which is an international standard for quality and risk management in aerospace and defense industry.

About Sabancı Holding

Sabancı Holding is the parent company of Sabancı Group, Turkey’s leading industrial and financial conglomerate. Sabancı Group companies are market leaders in their respective sectors that include financial services, energy, cement, retail and industrials. Listed on the Borsa Istanbul (BIST), Sabancı Holding has controlling interests in 11 companies that are also listed on the BIST.

Sabancı Group companies currently operate in 16 countries and market their products in regions across Europe, the Middle East, Asia, North Africa, North and South America. Having generated significant value and know-how in Turkey, Sabancı Holding has experienced remarkable growth in its core businesses. The Holding’s reputation, brand image and strong joint ventures helped further extend its operations into the global market.

Globally serving the world with our reinforcement technologies

reinforcing 2 out of every 3 aircraft tires,
and every 1 out of 3 car tires
produced in the world,

and we are getting **stronger for more!**

KORDSA
THE REINFORCER

END TO END APPROACH

Client Challenge

- Specific needs
- Detailed definition of requirements

Our Approach

- Fabric development and characterization
- Resin formulation
- Prepreg development and characterization
- End product design support
- Material library (for mechanical analysis)
- Mechanical analysis support
- Prototyping
- Production support

Results

- One solution partner
- Customized products
- Cost efficient
- Lightweight

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Thermoset Prepregs

Kordsa produces thermoset UD, woven and multiaxial fabric forms. The reinforcement material used in prepegs can be carbon, aramid, and glass fiber.

The primary resin matrice used is epoxy for thermoset prepregs.

Kordsa's range of thermoset prepregs include a wide range of resin formulations specially formulated by Kordsa for different applications and production processes.

Kordsa's new production line excels at high precision processes demanded by applications.

Typical features which we supply in the standard products:

- High toughness
- Class A surface
- Rapid cure transparent
- Rapid cure paintable
- High Tg
- Long out life

KORDSA THERMOSET PREPREGS

Resin Code	Tg			Chemical Structure	Recommended Curing Method			Usage Area	Misc
	Low Tg 120-150 °C	Mid Tg 150-180 °C	High Tg Above 180 °C		Press	Autoclave	Oven		
EF 13	-	-	-	PVB	√	√		Ballistic Applications, Hard Body Armor	High Toughness, High Energy Transfer
EF 14	-	-	-	Phenolic Modified PVB	√	√		Ballistic Applications, Hard Body Armor	Flame Retardant, High Toughness, High Energy Transfer
OM 12	120			Epoxy			√	Structural	Opaque White When Cured, OOA Moldable
OM 11	130			Epoxy	√	√		Structural; Fatigue Applications	Translucent When Cured, good fatigue performance
OM 10	140			Epoxy	√	√		Structural Composites, Al Sandwich Panels	High toughness, Opaque White When Cured, Tacky Version is Available
OM 13	120			Epoxy	√	√	√	Structural, Visual	Translucent When Cured, Tacky Version is Available
OM 13SF**	120			Higly filled modified Epoxy	√	√	√	Sandable Surfacing Film	Autoclave curable, Sandable, Class A Giving Surfacing Film.
OM15*	120			Epoxy	√	√		Visual Composites,	Translucent When Cured; Dicy Free Formulation Water Spot/white Wash Free Composites
OM 14	140			Epoxy-Vinyl Ester Hybrid	√			Structural	Fast Press Curable, Isothermally Curable and Hot Demoldable, Room Temp Storable for More Than a Year
CM 11		150		Epoxy	√			Visual Composites, Semi Structural	Fast Isothermally Press Curable, Class A Surface quality for painting, Hot Demoldable
CM 11SF**		150		Higly filled modified Epoxy	√			Sandable Surfacing Film	Fast Isothermally Press Curable Hot Demoldable, Sandable, Class A Giving SurfacingFilm.
CM 15		150		Epoxy	√			Visual Composites, Semi Structural	Fast Isothermally Press Curable, Class A Surface Quality For Painting, Hot Demoldable, Improved UV and Environmental Resistance, Improved Fiber Imprinting Resistance
CM 12		140		Epoxy	√			Metal-Composite Hybrid Structures	Fast Cure, Improved Metal Adhesion Properties, Isothermally Press Curable and Hot Demoldable, Suitable for Cataphoresis/ Hot Painting/Hot adhesive bonding
CM 14*		140		Epoxy	√			Whitespot/Waterspot Free Visual Composites,	Fast Cure, Class A Surface Quality, Visual Carbon Look, DICY Free Formulation Waterspot/Whitespot Free Composites
EF 10		170		Epoxy	√	√		Structural	Excellent Mechanical and Temperature Performance
EF 11			205	Epoxy	√	√		High Tg Required Applications,Secondary Airplane Structures, Engines, Helicopters	High Damage Tolerance and Good Impact Resistance
EF 12			220	Epoxy	√	√		High Tg Required Applications, Primary/Secondary Aircraft Structures, Engines, Helicopters	High Damage Tolerance and Good Impact Resistance
AV10AF**	120			Highly Modified and Filled Epoxy Matrix	√	√		Adhesive film prepreg	Adhesive Film Prepreg for Metal-Metal, Metal-Thermoset, Thermoset-Thermoset, Thermoset-Honeycomb Bonding Applications

*Limited shelf lifes ** Soon to be released

KORDSA
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Thermoplastic Prepregs

Kordsa produces woven based PP and PA thermoplastic prepregs. Matrices of the fiber based thermoplastic composite such as PP and PA have already been used notably in automotive, industrial, sports and leisure industries thanks to their cost saving and light weighting properties as well as being easy to process with the low processing temperature and pressure.

Kordsa's product range for polymer matrices is PP and PA6.6. The resin systems are specially formulated by Kordsa, which has excellent compatibility with reinforcing fibers such as E-glass or carbon. Prepreg is available as sheets with maximum dimensions of 1.2 m x 1.2 m. Laminates are usually produced from one to four layers depending on customer requirements.

Kordsa's woven glass fabric based PP thermoplastic prepreg exhibit 25% better flexural properties compared to its counterparts.

Typical features which we supply in the standard products:

- High stiffness
- High toughness
- Shorter manufacturing cycles
- No need for cold storage
- Recycling potential

Polymer Type	Fiber	Fabric Type	Fiber Volume Content (%)	Processing Temperature (°C)	Number of Layers	Usage Area
High crystalline polypropylene (PP)	E-glass, carbon	Woven	45-55	195-215	1 to 4*	Industrial, Sports & Leisure, Automotive
Polyamide 6.6 (PA6.6)	E-glass, carbon	Woven	45-55	275-300	1 to 4*	Industrial, Sports & Leisure, Automotive

*Number of layers can be changed depending on customer requirements.

Fabrics

Kordsa has a wide range of unidirectional and bidirectional fabrics (plain, twill, harnesssatin and basket). Carbon, glass or aramid fibres can be used as reincorforcement materials in traditional and hybrid fabrics. Woven fabrics can be suitable for prepreg production, vacuum infusion, RTM and wet layup.

Carbon fabrics

- Carbon fibres: from 1K to 50K
- Fabric width: 150mm – 1600mm
- Areal weight: 120 gsm – 1500 gsm
- Fabric type: Plain, Twill, Satin, Basket, Leno

WOVEN FABRICS

Fabric Code	Fiber	Areal Weight (g/m²)	Weaving Style	Warp Density (picks/cm)	Weft Density (picks/cm)
KCF1K PL120	CF 1K	120	Plain	9,0	9,0
KCF1K TW150	CF 1K	150	2X2 Twill	11,0	11,0
KCF3K PL160	CF 3K	160	Plain	4,0	4,0
KCF3K PL193	CF 3K	193	Plain	4,8	4,8
KCF3K PL200	CF 3K	200	Plain	5,0	5,0
KCF3K TW200	CF 3K	200	2X2 Twill	5,0	5,0
KCF3K PL224	CF 3K	224	Plain	5,6	5,6
KCF3K TW245	CF 3K	245	2X2 Twill	6,0	6,0
KCF3K TW285	CF 3K	285	2X2 Twill	7,0	7,0
KCF3K 4H285	CF 3K	285	4H Satin	7,0	7,0
KCF6K TW280	CF 6K	280	2X2 Twill	3,5	3,5
KCF3K PL288	CF 3K	288	Plain	7,2	7,2
KCF6K 4H380	CF 6K	380	4H Satin	4,7	4,7
KCF6K TW410	CF 6K	410	2X2 Twill	5,0	5,0
KCF12K TW400	CF 12K	400	2X2 Twill	2,5	2,5
KCF12K TW430	CF 12K	430	2X2 Twill	2,7	2,7
KCF12K PL480	CF 12K	480	Plain	3,0	3,0
KCF12K TW480	CF 12K	480	2X2 Twill	3,0	3,0
KCF12K TW600	CF 12K	600	2X2 Twill	3,7	3,7
KCF12K TW680	CF 12K	680	2X2 Twill	4,2	4,2
KCF24K PL640	CF 24K	640	Plain	2,0	2,0
CF24K TW800	CF 24K	800	2X2 Twill	2,5	2,5
KCF24K TW1200	CF 24K	1200	2X2 Twill	3,7	3,7

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UD FABRICS

Style	Fiber	Areal Weight (g/m²)	Warp Density (picks/cm)
KCF3K UD180	CF 3K	180	8,8
KCF6K UD200	CF 6K	200	4,9
KCF12K UD200	CF 12K	200	2,4
KCF12K UD300	CF 12K	300	3,6
KCF12K UD400	CF 12K	400	5
KCF24K UD650	CF 24K	650	3,7
KCF50K UD925	CF 50K	925	2,5
KCF50K UD1000	CF 50K	1000	2,7

*Suitable for high strength and high stability requirements.

UNBALANCED UD FABRIC

Fabric Code	Fiber	Areal Weight (g/m²)	Weaving Style	Warp Density (picks/cm)	Weft Density (picks/cm)
KCF2412K TW800 U	CF 24K, 12K	800	2X2 Twill	4,5	1,0

HYBRID FABRICS

Fabric Code	Warp Yarn	Warp Density (picks/cm)	Weft yarn	Weft Density (picks/cm)	Areal Weight (g /m²)	Weaving Style
KCA6K336 PL221	CF 6K	3,0	AR 3360dtex	3,0	221	Plain
KCA6K336 PL265	CF 6K	3,6	AR 3360dtex	3,6	265	Plain
KCA6K336 TW265	CF 6K	3,6	AR 3360dtex	3,6	265	2X2 Twill
KCG6K410 PL243	CF 6K	3,0	S-Glass	3,0	243	Plain
KCG6K410 PL284	CF 6K	3,5	E-Glass	3,5	284	Plain
KCG6K410 PL292	CF 6K	3,6	E-Glass	3,6	292	Plain
KCG6K410 TW292	CF 6K	3,6	E-Glass	3,6	292	2X2 Twill

* Hybrid fabrics can be designed for cost and performance optimization.

ARAMID FABRICS

Fabric	Fiber	Areal Weight (g/m²)	Weaving Style	Warp Density (picks/cm)
KAF670 PL160	Aramid 670 dtex	160	Plain	12,2
KAF930 PL200	Aramid 930 dtex	200	Plain	10,6
KAF3140 PL400	Aramid 3140 dtex	410	Plain	6,4
KAF3300 PL440	Aramid 3300 dtex	440	Plain	6,7

OTHER FACILITIES

Fabric Development, Inc.

(FDI) was established in 1972 to manufacture specialty woven fabrics to meet specialty end use requirements. In time, FDI has greatly expanded its capabilities to work with all high performance fibers, including Carbon (standard to ultra-high modulus), Aramid (Kevlar&Twaron), Spectra, Ceramics, Quartz, Teflon, Nomex and Vectran. FDI has manufactured these fibers in a variety of fabric geometries, hybrid structures, polar weaves and multilayer fabric structures. This capability allows FDI to serve the expanding needs of specialty fabric applications.

Textile Products, Inc.

(TPI), operating as a Kordsa company, is a specialty textile manufacturer, experienced in the development and production of custom fabrics. TPI offers a wide range of standard fabrics as well as custom design textiles engineered to meet specific requirements including: Uni-directional, Bi-directional, Multi-directional and Hybrid fabrics and tapes. TPI also has considerable experience with all available yarns, including Carbon-Standard, Intermediate and High Modulus, Aramid-KevlarTM & TwaronTM, Ceramic-NextelTM & NicalonTM, Quartz, Metallic Wires, Nickel Coated Carbon and Commingled Thermoplastics.

Advanced Honeycomb Technologies (AHT)

Operating as a Kordsa company, manufactures a wide range of honeycomb core used in products as diverse as commercial and military aircraft, communications and transportation equipment, space vehicles, construction materials and recreational and sporting goods.

PRODUCTS

AHN4120 Aramid Fiber/Phenolic Coated Honeycomb

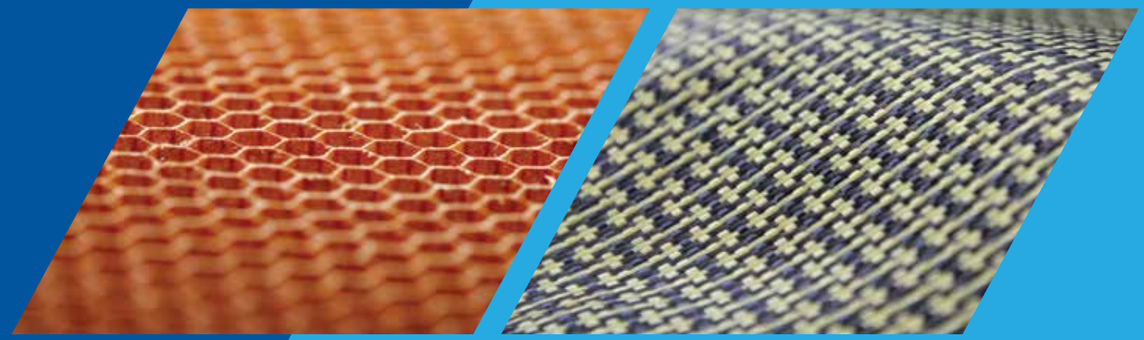
AHN4120 is an Aerospace Grade Nomex® Honeycomb which exhibits high strength and toughness in a small cell, low density, non-metallic honeycomb.

AHN7800 Aramid Fiber / Phenolic Coated Honeycomb

AHN7800 is a Commercial Grade Nomex® honeycomb particularly suited for use where resistance to corrosive attack and moisture are important.

AHK Kraft Paper / Phenolic Coated Honeycomb

AHN AHK is a structural Kraft paper honeycomb which conforms to MIL-H-21040 C and ASTM E 1091.



KORDSA | Sabancı Üniversitesi

COMPOSITE TECHNOLOGIES CENTER OF EXCELLENCE

REGISTERED AS 9100

Composite Technologies Center of Excellence is the key development facility in composite industry in collaboration with Sabancı University to bring together engineers, researchers, faculty members, students, entrepreneurs and designers under one roof including:

- Kordsa Prepreg Pruduction Line
- Kordsa Composite Reinforcement R&D Center
- Sabancı University PhD Programs
- Incubation Centers
- Kordsa – Sabancı University Joint Composite R&D Labs

Sabancı Üniversitesi

SU | IMC SABANCI UNIVERSITY INTEGRATED MANUFACTURING TECHNOLOGIES RESEARCH AND APPLICATION CENTER

Sabancı Group established a “world university” under Sabancı Foundation’s stewardship in 1994. Instead of choosing a university as a template or replicating existing examples and institutions, a novel and unique university was designed during its founding. Sabancı University opened its doors to students in 1999 and has since set an example for many other universities. The main differentiator of Sabancı University is its unique educational system. Academic programs at Sabancı University are innovative and interdisciplinary.

Sabancı University was named “The Most Innovative and Entrepreneurial University” in 2012, 2015, 2016 and 2017 in the Ministry of Science, Industry and Technology’s Entrepreneurial and Innovative Universities Index. In 2016, Sabancı University maintained its position in the global top 500 rankings compiled by prestigious organizations such as Times Higher Education and QS. In 2016, the Sabancı University ranked 44th globally in the Times Higher Education (THE) “Best 150 Universities under 50 Years Old” list, which evaluates the performance of young, rising universities. Meanwhile, the University rose four spots to place 18th in the 2017 Times Higher Education (THE) “BRICS and the Best Universities in Emerging Economies” ranking. Recently, the University ranked 34th in the Times Higher Education (THE) “Asian Universities” rankings.

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