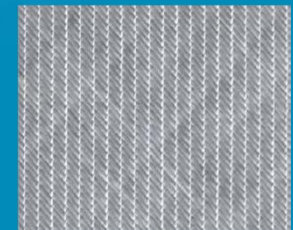


**RÜZGAR TÜRBİN
KANATLARINDA
KULLANILAN CAM
KUMAŞ & DOKUMA İÇİN
CAMELYAFI İPLİĞİ**

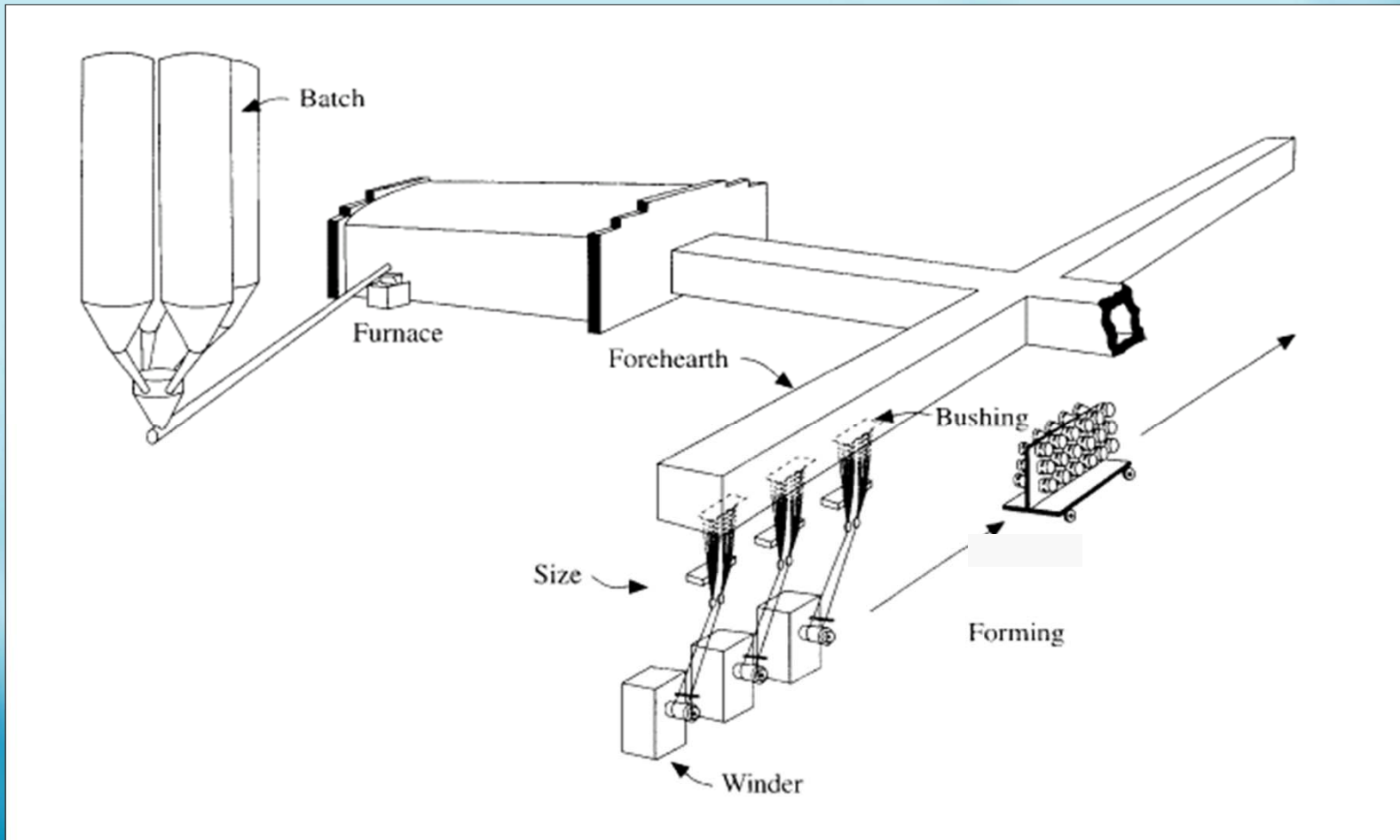


CAMELYAF TAKVİYELERİ;

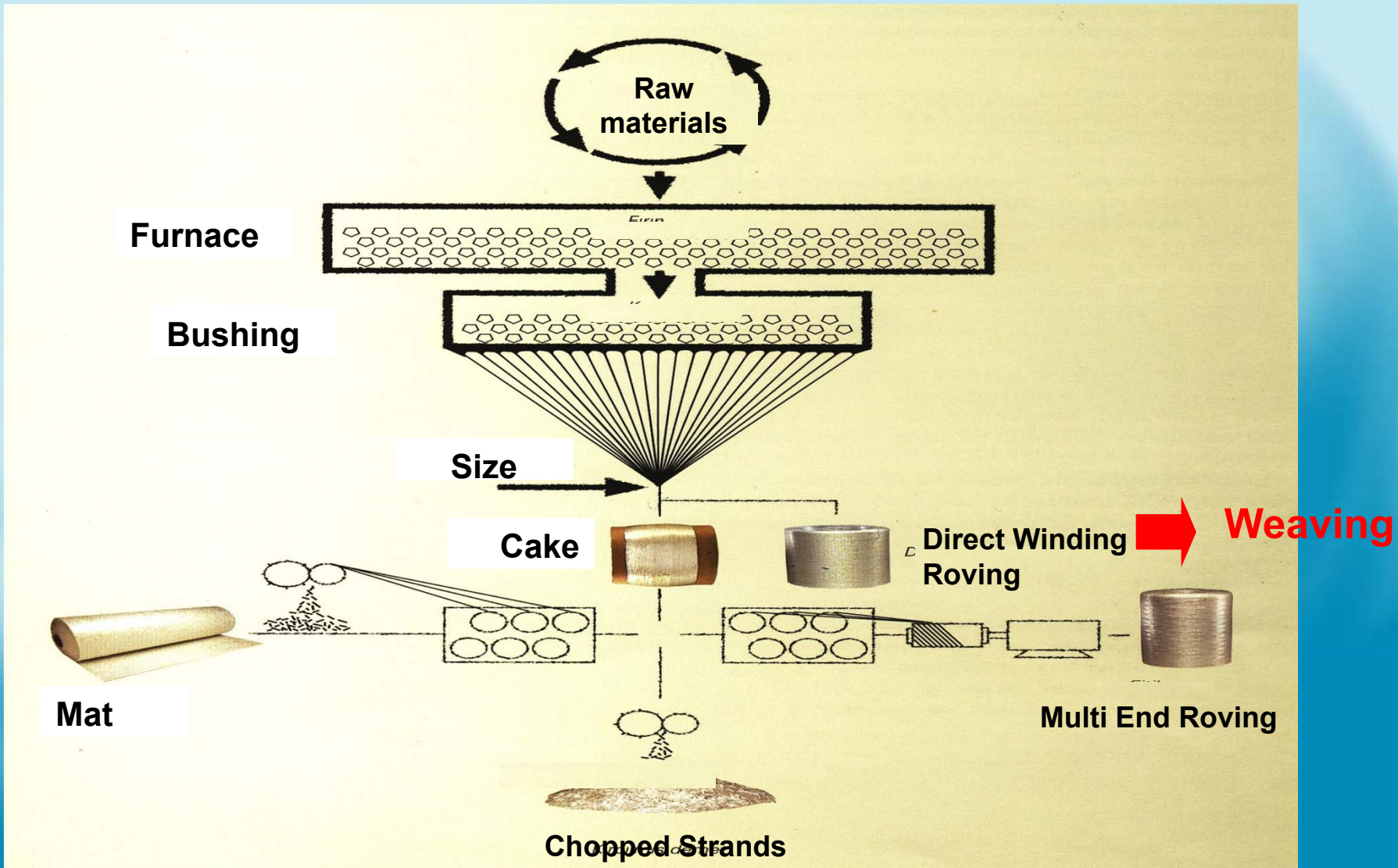
- Single End Roving
- Multi End Roving
- Chopped Strands
- Chopped Mat
- Milled Fiber
- Continuous Mat
- Weaving



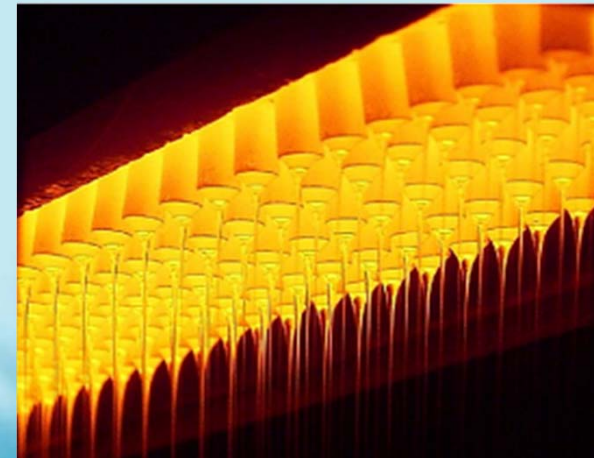
CAM ELYAFI ÜRETİM ŞEMASI / GLASS FIBER MANUFACTURING SCHEMA; E-Glass furnace:



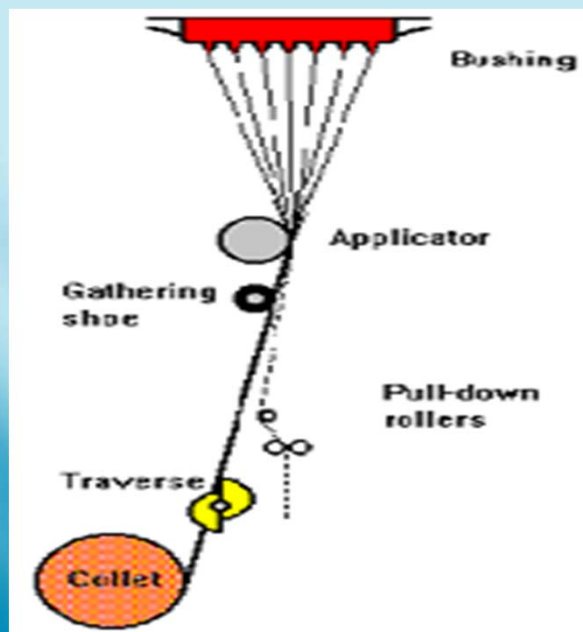
ELYAF ÜRETİMİ



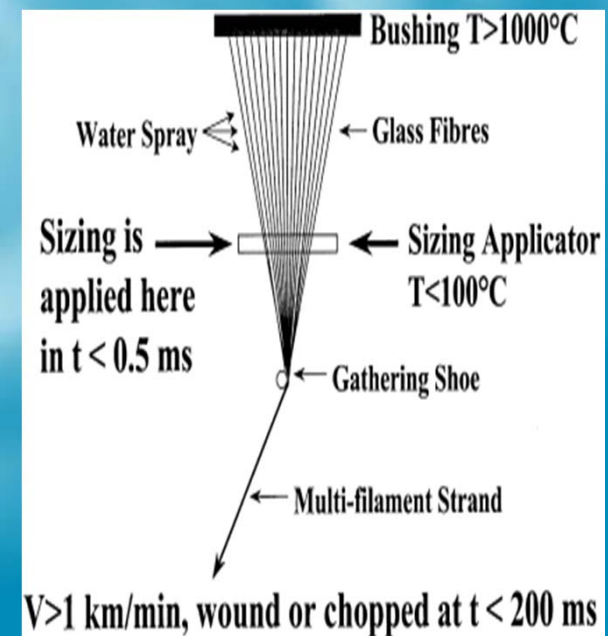
Bushing picture and schematic diagram of winding process



Bushing



Winding process

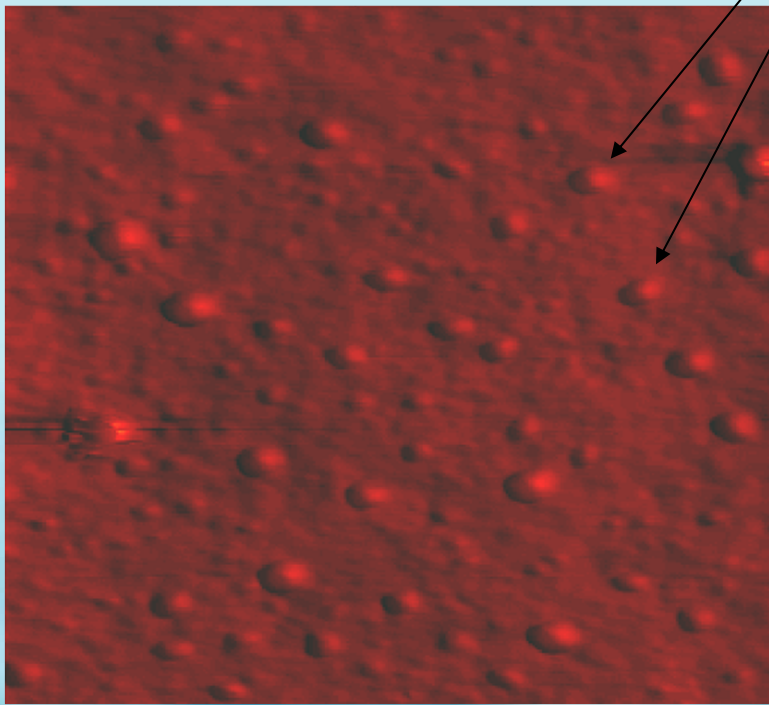


Bağlayıcı ;

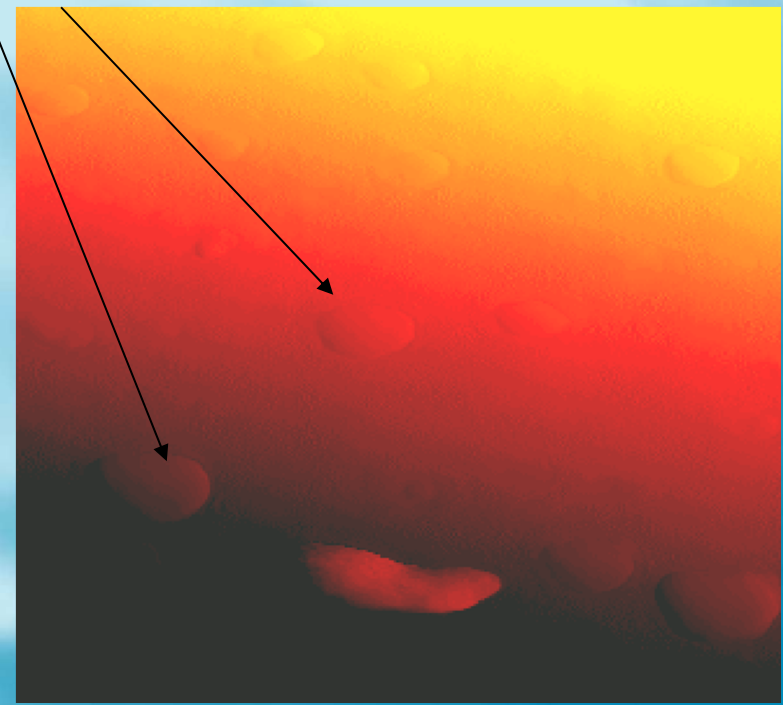
- 1- Coupling agent***
- 2- Film former agent***
- 3- Antistatic agent***
- 4- Lubricating agent***
- 5- Antioxidizing agent***
- 6 - Plastifying agent***

BAĞLAYICI İLE ELYAF YÜZEYİ ARASINDAKİ İLİŞKİ/ INTERACTION BETWEEN SIZE AND FIBER SURFACE;

Film formers

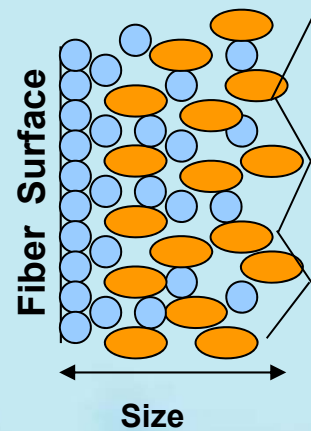


1 μ m

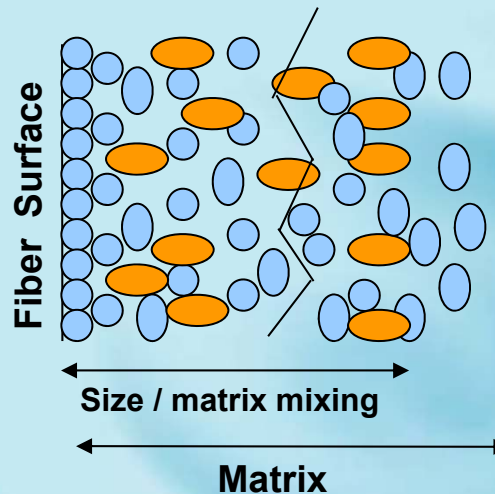


1000 nm

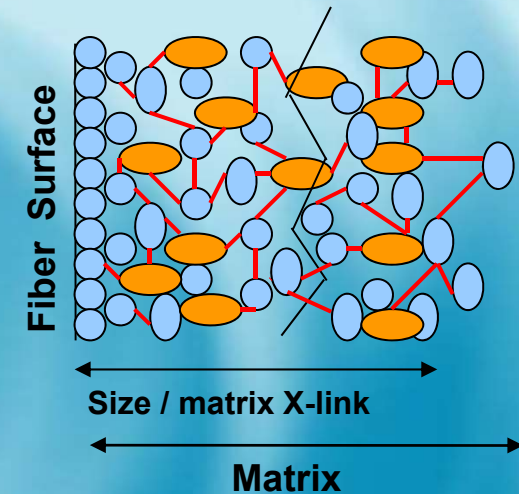
INTERACTION BETWEEN SIZE AND POLYMER MATRIX (Thermoset resin);



1- Fiber



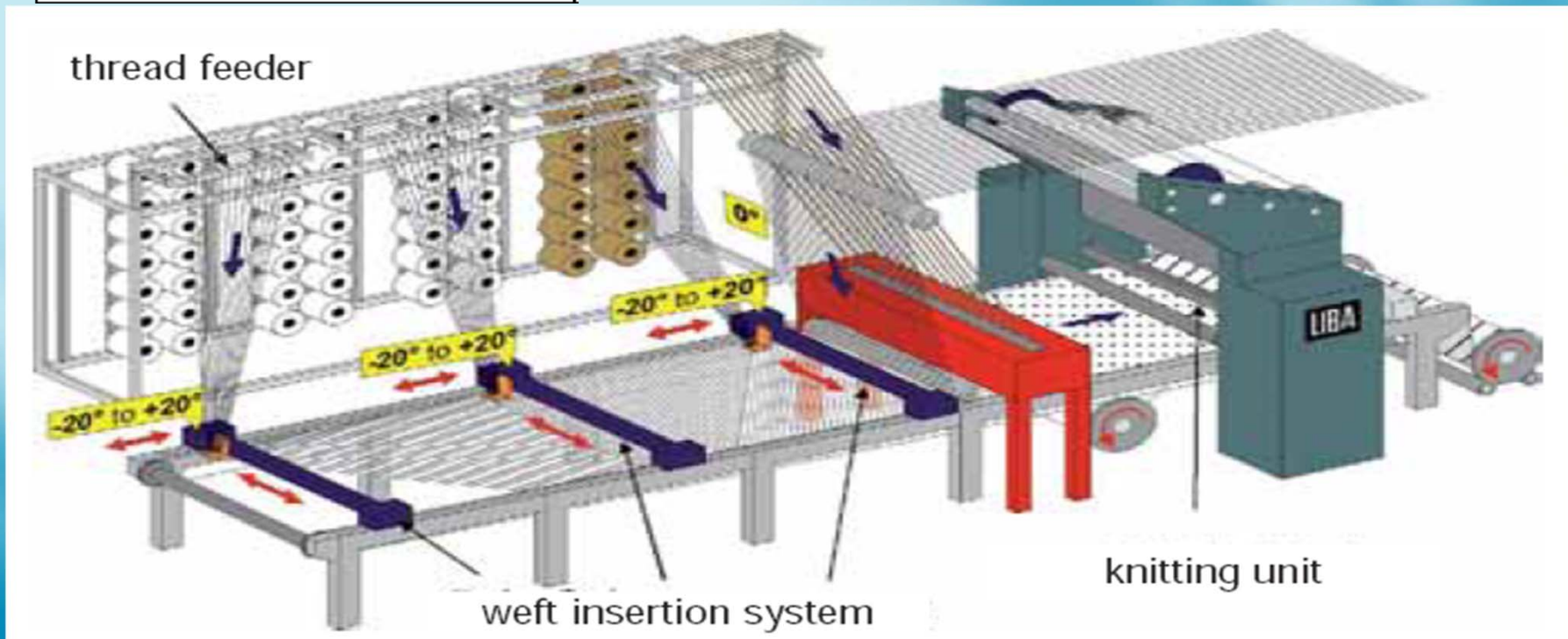
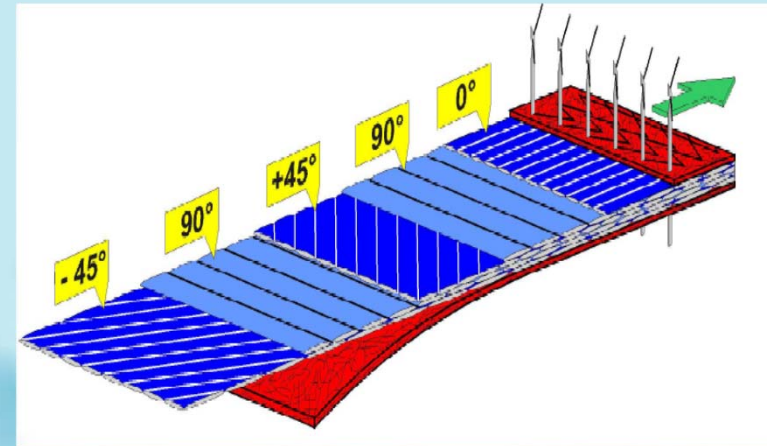
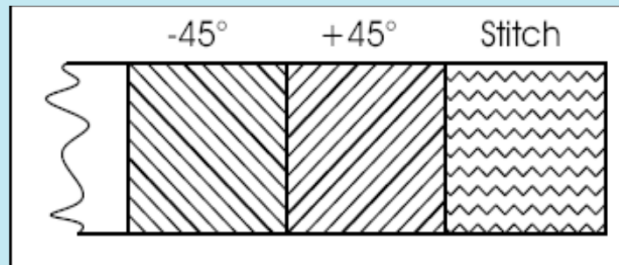
2- Fiber+ Matrix



3- Curing

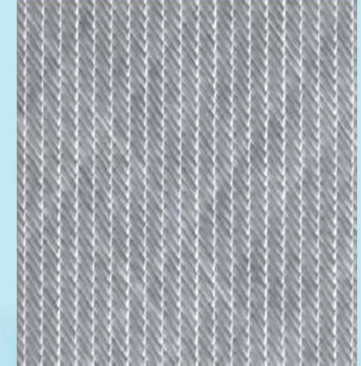
-  Size (Film formers)
-  Matrix (Thermoset resin)
-  Silane (Coupling agent)

DOKUMA / WEAVING;



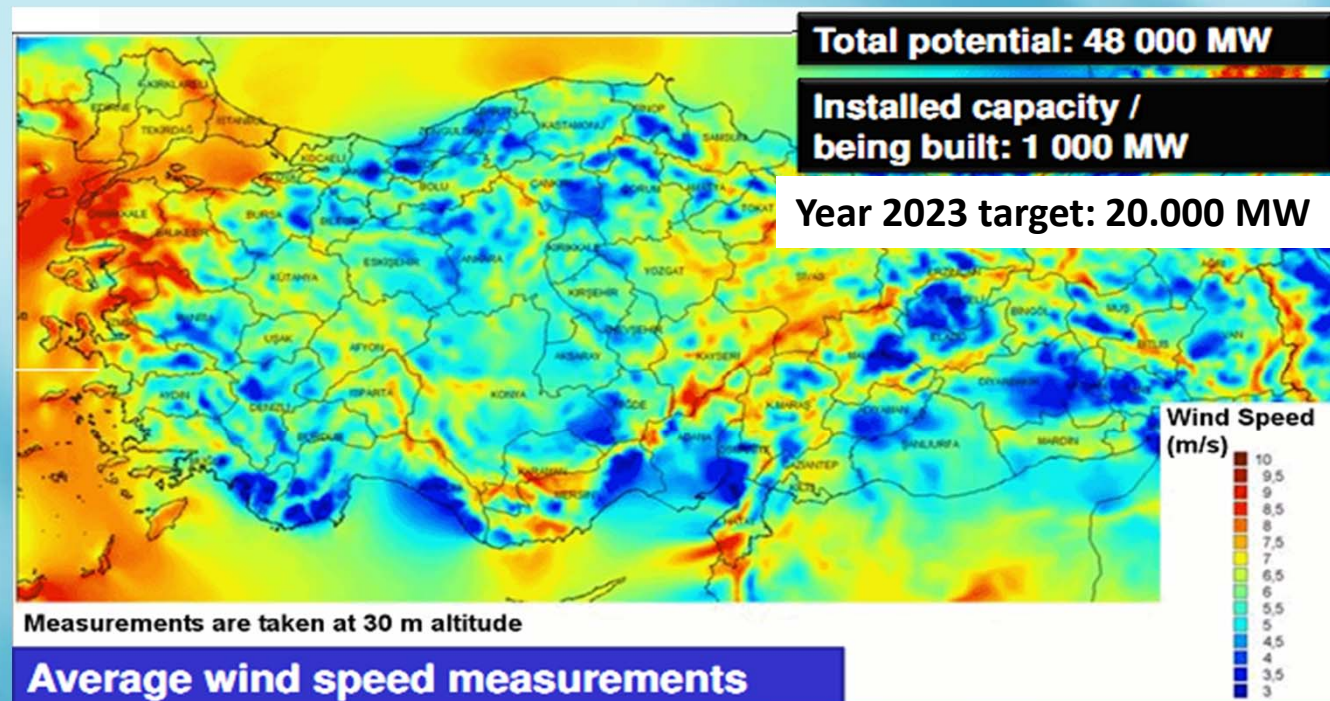
GLASS FIBER WEAVING APPLICATIONS;

- Boat manufacturing
- Transportation and otomotive industries
- Wind turbines



Wind Energy in TURKEY;

In 2017 the total electricity production capacity of the wind turbines in TURKEY is about 6.000 MW and it is estimated to rise up to 15.000 -20.000 ! MW in 2023.





1MW= 6-7 tons glass fiber

DESIGN PROCESS;

- Design of target specifications
- Design of size
- Simulation of customer processes and tests
- Mechanical performance tests and measurements

Target Specifications:

By choosing a widely used products in the market;

Wetting time	: max.10 sec.
L.O.I	: 0.4 – 0.7%
Moisture content	: max. 0.03 %
Fuzz ratio	: max. 0.150 %
Tex	: (% ± 5) gr/1000 m

Design of size

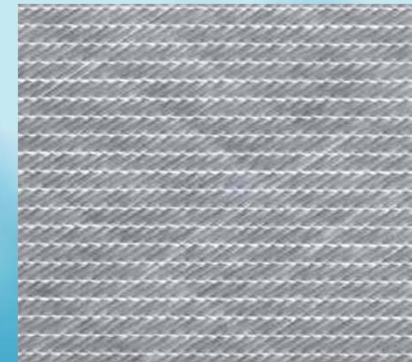
Epoxy compatible coupling agents, various types of film formers, appropriate lubricating agents and different types of antistatic agents were utilized.

Appropriate size formulation were stablished and consequently target specifications were achieved.

CUSTOMER PROCESS SIMULATION AND RELATED TESTS



**Multiaxial weaving
production**



Fuzz ratio;

CE : 0,070 %

**Competitor : 0,110 %
(RÜ)**



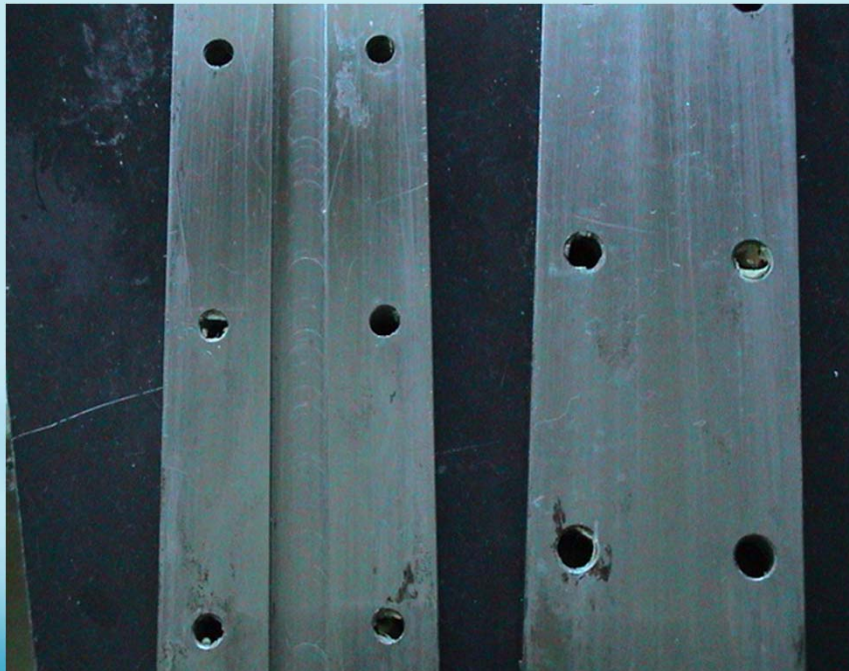
MECHANICAL TESTS;

- **Direct winding roving rupture test**

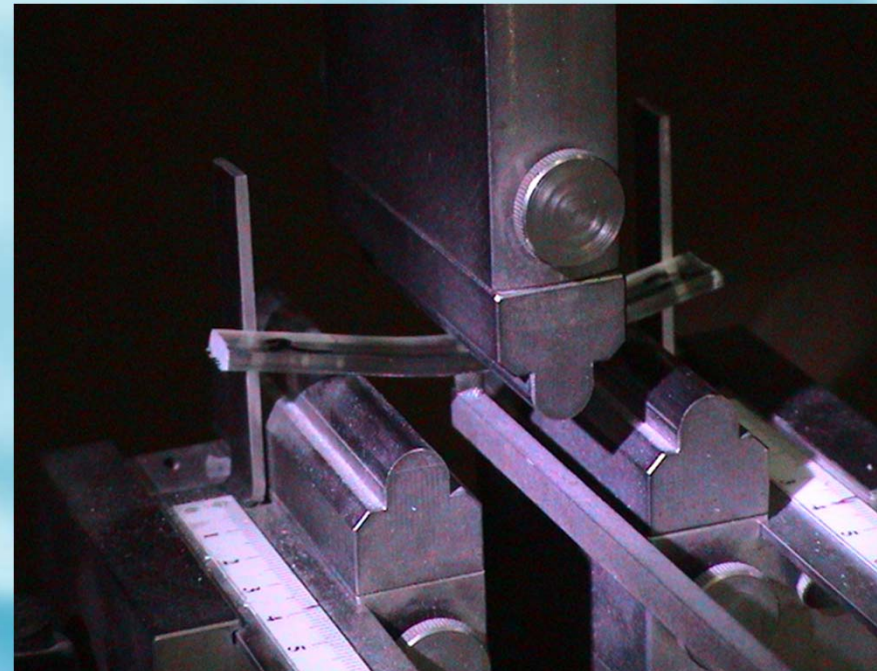
Parameters	Unit	Test Method	CE	RÜ
L.O.I	%	ISO 1887	0,55	0,50
Tensile	N	ISO 527	1096	1110
Tex	gr/1000 m	ISO 1889	2335	2361
Rupture/ Tex	N/gr/1000 m		0,465	0.471

COMPOSITE PERFORMANCE TESTS ;

1- Composites with Direct winding rovings



a- Mold for producing composite bars



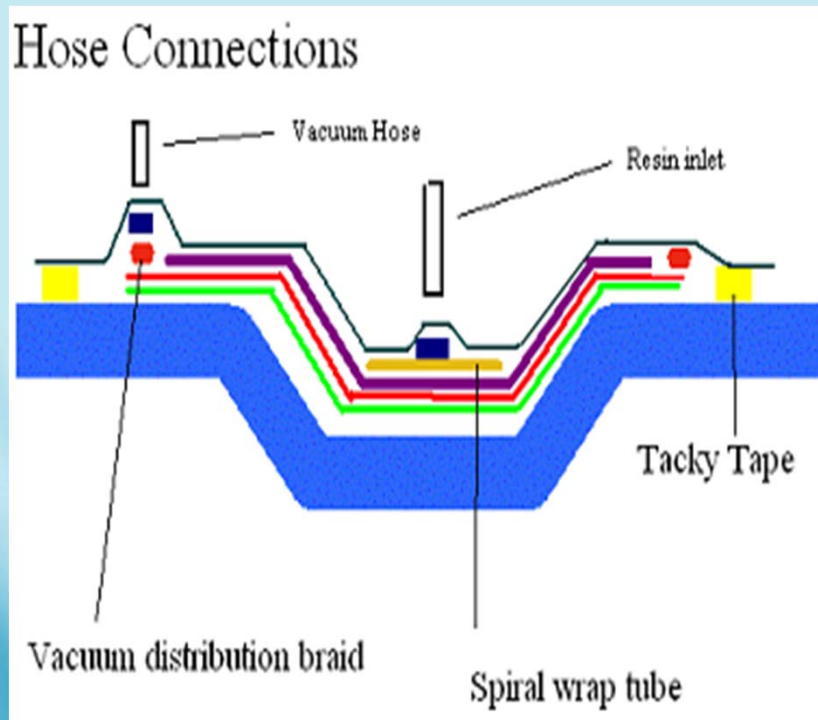
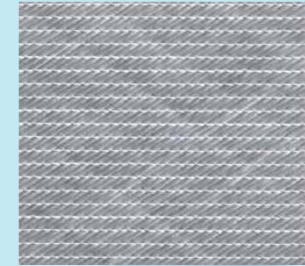
b- 3 point bending test

1-1- Mechanical performance of the composites with direct winding rovings

Parameters	Unit	Test Metod	CE			Competitor (RÜ)		
			Epoxy	Polyester	VE	Epoxy	Polyester	VE
Flexural Strength	MPa	ISO 527	610	667	645	539	694	734
Flexural Strength Modulus	MPa	ISO 527	22434	20395	20024	24151	21092	23203
Glass Content	%	ISO 1172	45.5	46.3	43.6	47.2	48.6	48.6
Flexural Strength/ Glass Content			13.4	14.4	14.8	11.4	14.3	15.1

MECHANICAL PERFORMANCE TESTS ;

2- Composites with multiaxial weaving



a- Vacuum infusion set up

b- Pilot vacuum infusion system

2-1- Mechanical performance of the composites made from multiaxial weaving

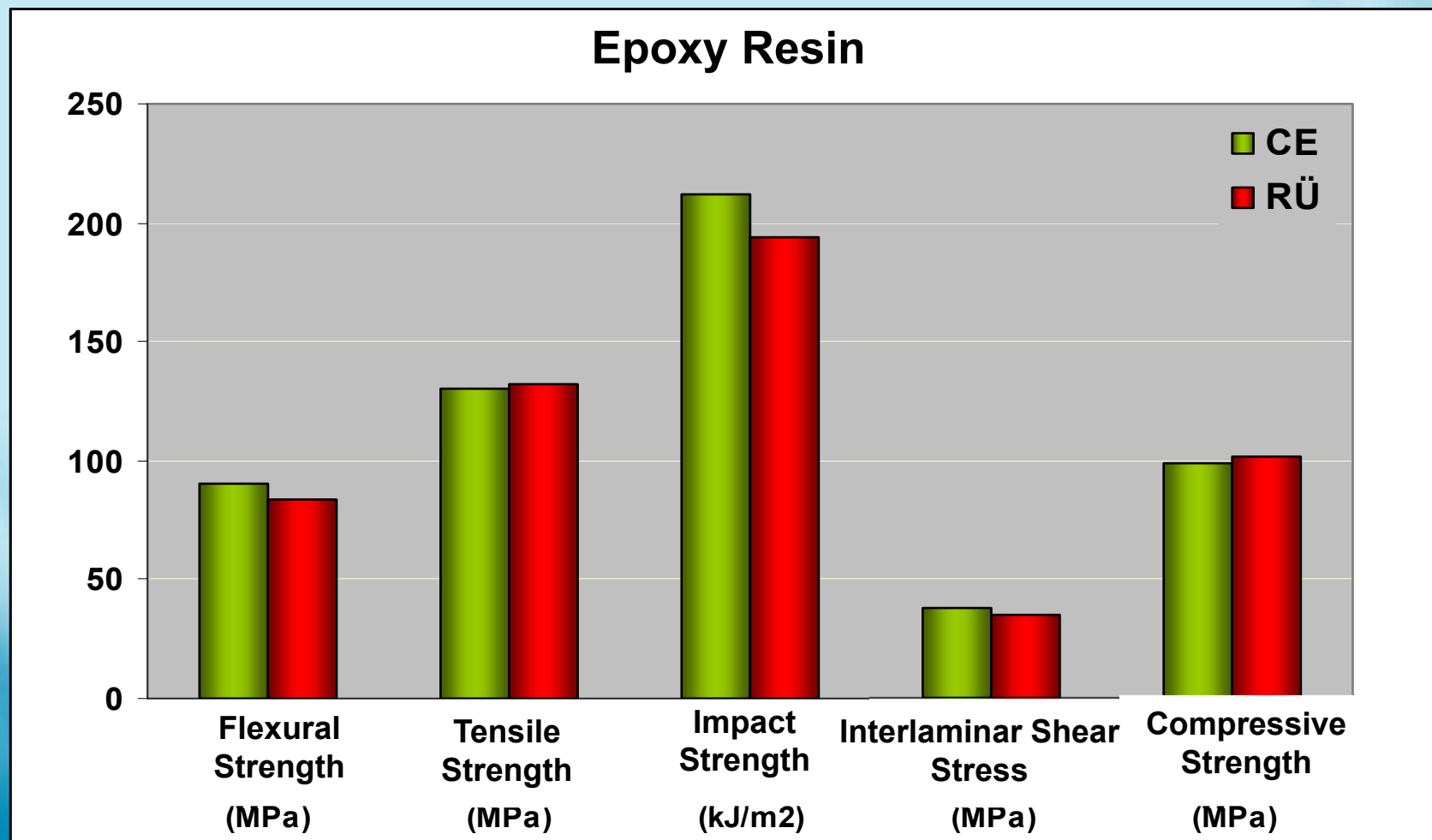
Parameters	Unit	Test Method	CE			Competitor (RÜ)		
			Epoxy	Polyester	VE	Epoxy	Polyester	VE
Flexural Strength	MPa	ISO 178	90	112	92	84	103	85
Flexural Strength Modulus	MPa	ISO 178	1101	1334	1070	937	1285	527
Deformation at break	mm	ISO 178	18,6	17,8	18,3	19,3	14,7	16,6
Tensile Strength	MPa	ISO 527	130	168	132	132	124	139
Flexural Strength Modulus	MPa	ISO 527	8827	11040	10008	8300	9424	10517
Elongation at break	%	ISO 527	7,6	3,7	4,6	8,8	3,3	3,5

Parameters	Unit	Test Method	CE			Competitor (RÜ)		
			Epoxy	Polyester	VE	Epoxy	Polyester	VE
Izod Impact Strentgh (11J, unnotched)	kJ/m ²	ISO 180	212	147	167	194	130	174
Charpy Impact Strentgh (7.5 J, unnitched)	kJ/m ²	ISO 180	148	98	127	153	97	132
*Interlaminar Shear Stress	MPa	ISO 14130	37,7	34,3	57,1	35,1	33,3	38,3
*Compressive Strength	MPa	ASTM D695	98,4	96,8	92,8	102,7	88,1	93,8
Glass content	%	ISO 1172	56,5	51,6	57,1	57,9	51,3	56,2

* Tests were made in İzmir Institute.of High Technology.

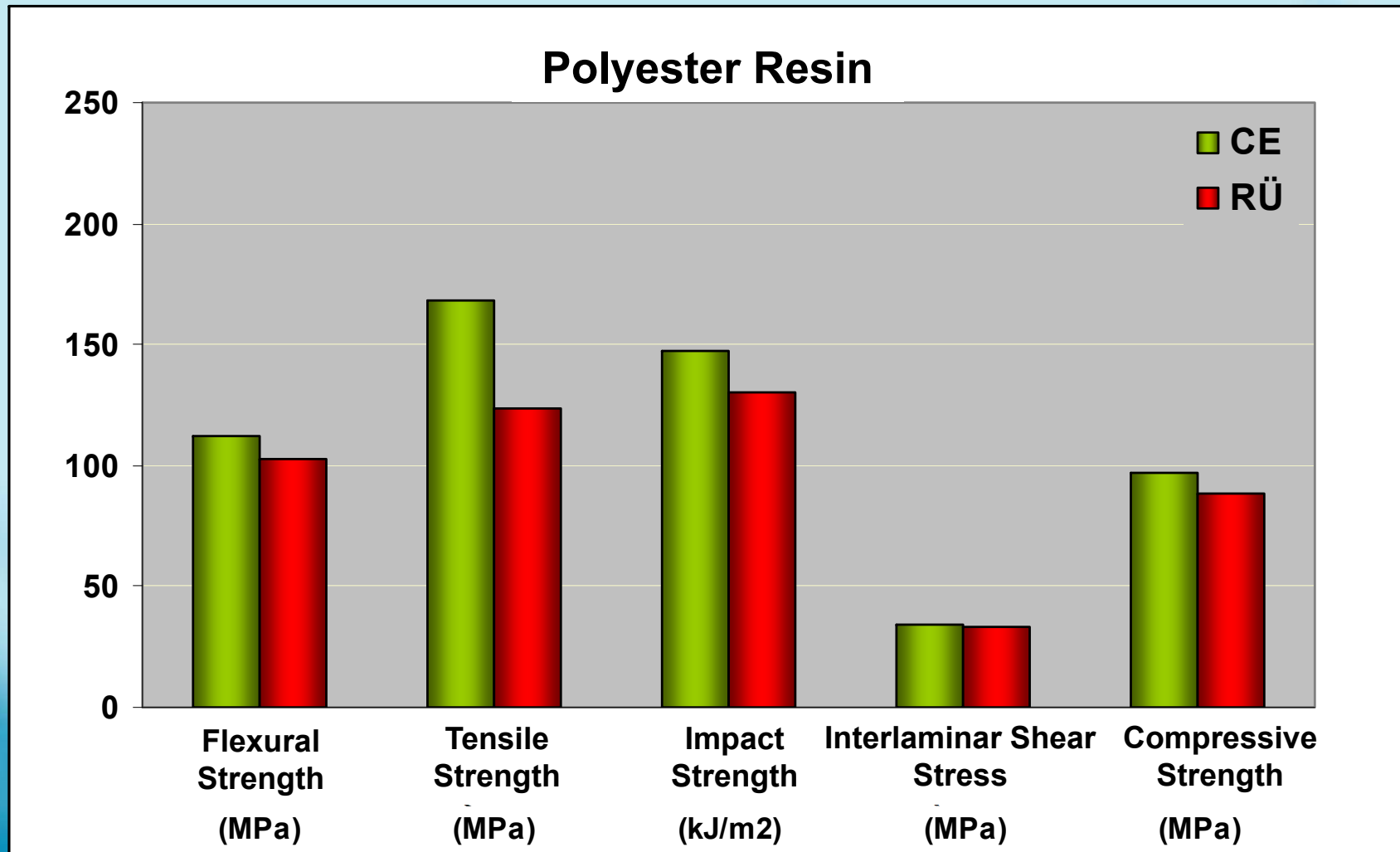
- Mechanical Performance Tests of composites made from Multiaxial weavings**

Glass Content: % 57



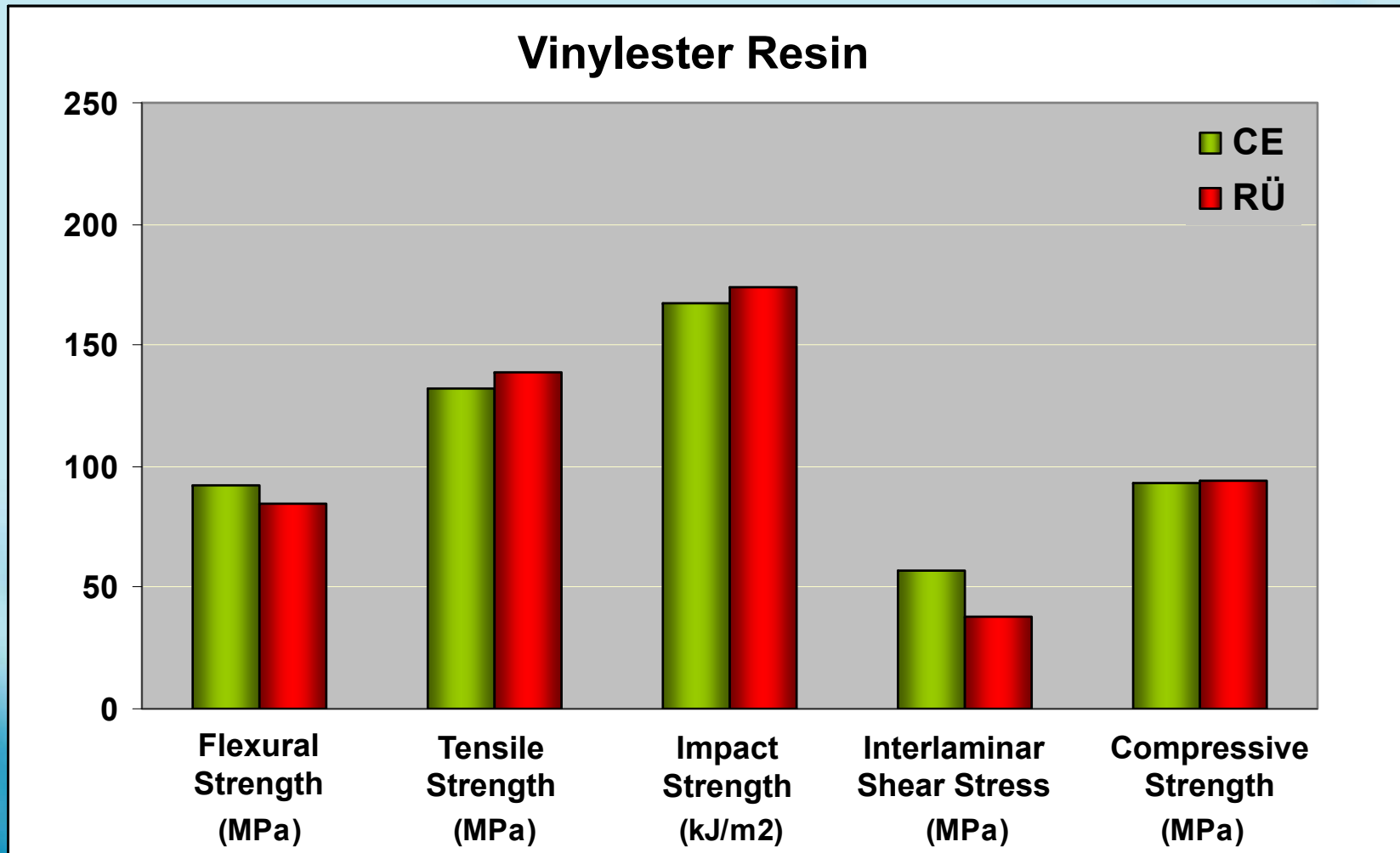
- **Mechanical Performance Tests**

Glass Content: % 52



- **Mechanical Performance Tests**

Glass Content: % 57



RESULTS;

- Direct Winding Roving **WR6** is compatible with Epoxy, Unsaturated Polyester and Vinyl ester.
- Processing is easier in comparison with competitors.
- Cam Elyaf product has the capacity to compete with alternative products in the market.

Yeni CAMELYAF Yatırımımız

Balıkesir 70.000 Ton





Teşekkür ediyoruz..
THANK YOU..