



**P.R.China·Shandong·Tai'an**

**2013-3-12**

**Sinoma**  
**中国中材**

泰山玻璃纤维有限公司  
Taishan Fiberglass Inc.

# Catalogue



**Company Profile**



**The application of TCR in wind energy**



**The application of S-1 HM<sup>TM</sup> in wind energy**



## Company Profile

China National Materials Group Corporation Ltd.(Sinoma) established in 1983, which as a central government-administered enterprise directly under the administration of State-owned Assets Supervision and Administration Commission of the State Council (SASAC). A world`s pioneering non-metallic materials manufacturer and a global leading provider of non-metallic materials technology, equipment & engineering.

China National Materials Company Limited is established by China National Materials Group Corporation and listed on the main board of Hong Kong Stock Exchange on December 2007. The Company is mainly engaged in cement equipment and engineering services, glass fiber, cement and high-tech materials business.

Taishan Fiberglass Inc.(CTG), is a wholly owned subsidiary company of China National Materials Co., Ltd.(01892.HK), and is committed to the expansion and innovation of the field of fiberglass composites.



# Company Profile

**Taishan Fiberglass Inc.**

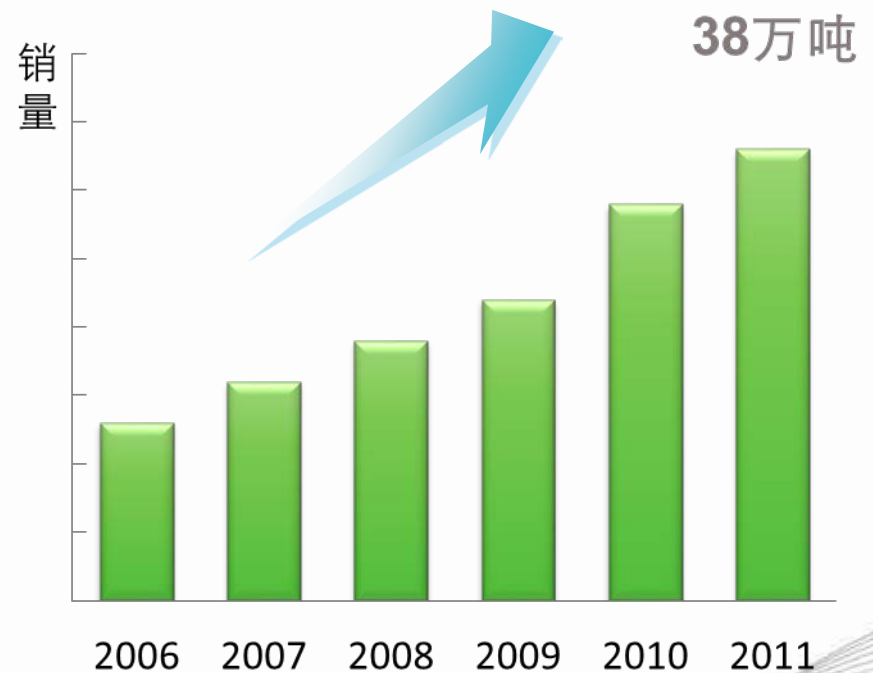


# Company Profile

## Footprint

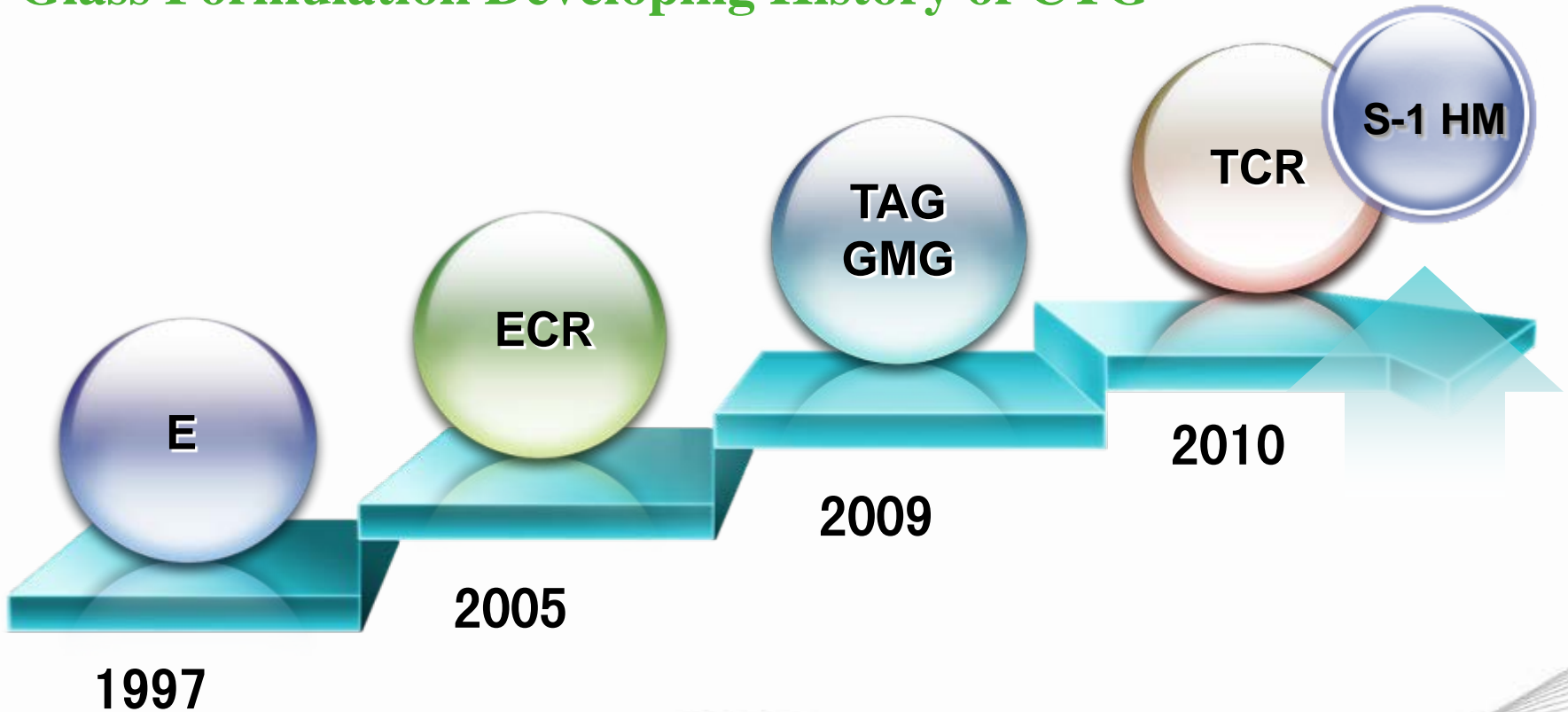
## Achievements

**In year 2011, CTG had achieved sales volume up to 380K MT with sales revenue of 2.6 billion RMB. Its products are exported to over 60 countries and regions, including US, Europe, ME, etc.**





## Glass Formulation Developing History of CTG





## Products Series



- E-glass Roving
- Chop Strand
- Yarn
- Axial Tapes
- Woven Roving
- CSM.
- Electronic Fabrics
- Knitted Mat

## Products Application

**Transportation, Electricity, Energy, Electronics, Construction, Water Supply, Environment Protection, etc.**



## Quality Assurance System

**Taishan Fiberglass Inc., is committed in scientific and standardized management and has acquired certificates of International Quality Management System (ISO9001), Environmental Management System (ISO14001); Occupational Health and Safety Management System (GB/T28001) and products are awarded Det Norske Veritas Type Approval Certificate (DNV), Lloyds Register of Shipping (LR), Germanischer Lloyd (GL) and China Classification Society (CCS), etc.**



## Prospect



**Total Capacity 700,000MT/Y, included roving 570,000MT/Y, yarn 130,000MT/Y, electronic woven roving 300 million meters in 2020.**

**Capacity in Tai an 480,000MT**  
 6 lines for roving  
 1 line for high-strength fiber  
**Capacity in Zoucheng 220,000MT**  
 2 lines for roving  
 3 lines for yarn





# TCR Fiberglass

## TCR Fiberglass Acid Resistance Principle

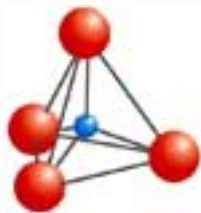
### TCR Fiberglass Composition

SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	CaO	MgO	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	ZrO <sub>2</sub>	K <sub>2</sub> O	Na <sub>2</sub> O
60.0	12.9	22.7	2.55	0.30	0.30	0.30	0.22	0.57

### TCR Acid and Corrosion Resistance Principle :

➤ **TCR fiberglass has much more silica framework**

The more silica tetrahedron it has in glass framework, the better acid and corrosion resistance it will have. Because in the acid medium except the silica framework, most of the other ion will be dissolved, which lower the strength. The content of SiO<sub>2</sub> in TCR formulation reaches 60%, and the glass has lots of silica framework which leads to high acid resistance property.

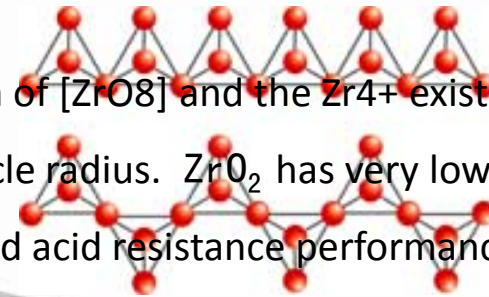


➤ **TCR glass with formulation of boron-free & fluoride-free**

$B_2O_3$  easily generates glass phase separation. The phase separation is due to the oxygen fight between  $SiO_2$  and  $B_2O_3$  when the glass cooled, hence, the existence of  $B_2O_3$  will destroy the silica framework which lower the glass acid resistance and strength in some extent. TCR doesn't contain  $B_2O_3$ , which eliminates the glass phase separation. That's the important reason of TCR has strong performance of acid resistance.

➤ **ZrO<sub>2</sub> contains a superior acid & alkali corrosion resistance, which brought into TCR formulation**

In silicate formulation,  $ZrO_2$  has only one coordination of  $[ZrO_8]$  and the  $Zr^{4+}$  exists as an external body in glass structure due to its big particle radius.  $ZrO_2$  has very low solubility, but its superior property is to increase the alkali and acid resistance performance of glass.



## Performance of TCR vs E-glass

Performance	Test Standard/Method	E-glass	TCR	Difference
Density g/cm <sup>3</sup>	ASTM D 1505	2.59	2.60	↑0.39%
Softening Temperature °C	ASTM C 338	840	910	↑8.3%
Refractive Index	Immersion Method	1.569	1.569	0
Elasticity Modulus GPa	Sonic Method	75	81	↑8%
Breaking Strength MPa	ASTM D 2343-95	2250	2367	↑5.2%
Acid Weightlessness %	96°C 10%H <sub>2</sub> SO <sub>4</sub> , 96h	40.17	3.9	↓90.3%
Expansion Coefficient 10 <sup>-6</sup> K <sup>-1</sup>	ASTM D 696	5.98	6.0	↑0.33%
Volume Resistivity Ω.cm	ASTM D 257	14.7	14.8	↑0.68%
Dielectric Constants	ASTM D 150	6.7	6.7	0

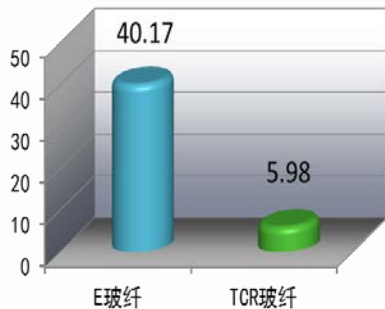


## TCR vs E-glass Acid Resistance Performance Testing

Tested Sample	Testing Item	Testing Method	E-glass	TCR
Direct Roving Vinyl resin	Laminates sheer Strength Loss	ASTM D2344	90%	7.25%
	Fiber Content	ISO 1172	71%	71%

FRP Composites in 10% H<sub>2</sub>O<sub>4</sub>, 96°C, 96h Acid Resistance Comparison Pictures

耐酸失重对比



层间剪切强力损失



TCR



E-Glass



## TCR Typical Application



High Pressure Gas  
Cylinder



High Pressure Pipe Line



Flue Gas Desulfurization Tower

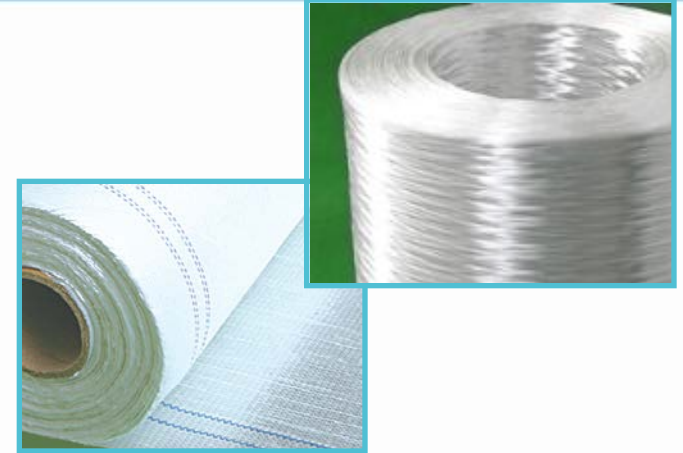


Wind Blade

## TCR Applied in Wind Energy

### Rovings for Wind Energy

Product Code Example: TCR920W-2400-17



Fiberglass Type	Product Name	Nominal Liner Density Range	Nominal Filament Diameter Range	Applied Resin
E-glass	T912	300tex~2400tex	14 $\mu$ m~17 $\mu$ m	UP/VE
	T920W	300tex~2400tex	14 $\mu$ m~17 $\mu$ m	EP
TCR-glass	TCR912	300tex~2400tex	14 $\mu$ m~17 $\mu$ m	UP/VE
	TCR920W	300tex~2400tex	14 $\mu$ m~17 $\mu$ m	EP

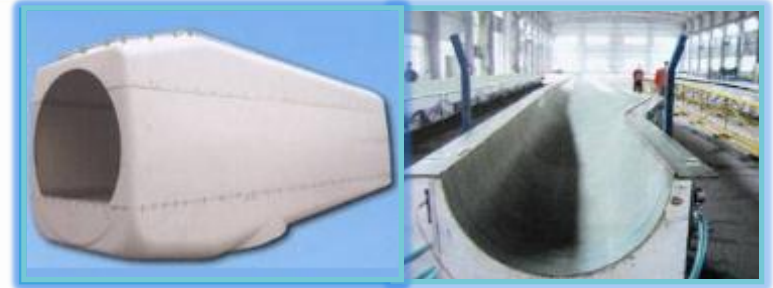


# TCR Applied in Wind Energy

## Fabrics for wind blades

Products Type	Product Name	Width Range	Applied Resin	
Warp Knitting UD	EUL1200 (0) EP-600E7	100~2540mm	UP/EP/VE	
	EUL1200 (0) C50EP-600E6	100~2540mm		
Warp Knitting Biaxial	EBX800 (+45/-45) EP-1270E6	100~2540mm		
	EBX1200 (+45/-45) EP-1270E6	100~2540mm		
Warp Knitting Triaxial	ETL1000 (0/+45/-45) EP-1270E6	100~2540mm		
	ETL1200 (0/+45/-45) EP-1270E6	100~2540mm		
	ETL1215 (0/+45/-45) EP-1270E6	100~2540mm		
	ETT1200 (+45/90/-45) EP-1270E6	100~2540mm		
Weaving UD	ECW700 (0) -900	100~3400mm		UP
	ECW1200 (0) -650	100~3400mm		

## Fabrics applied for nacelle & its mould



Products Type	Product Name	Width Range	Applied Resin
PP Compound Mat	ECW600/180(pp)/624(0,90)-1270	200~2540	UP
	ECW600/180(pp)/600-1270	200~2540	
Warp Knitting Biaxial	EBLT800 (0/90) UP-1270E7	100~2540	
	EBLT600 (0/90) C300UP-1270E7	100~2540	
	EBLT800 (0/90) C225UP-1270E7	100~2540	
Warp Knitting Quadraxial	EQLT800 (0/+45/90/-45) UP-1270E10	100~2540	
	EQLT2000 (0/+45/90/-45) UP-1270E5	100~2540	
	EQL2000 (0/+45/90/-45) UP-1270E6	100~2540	
	EQT2000 (0/+45/90/-45) UP-1270E10	100~2540	



## TCR Multi-Axial Fabrics Composites Performance Testing Data

### UD EUL1200(0)EP Laminated Sheet

Testing Item		Testing Standard	Testing Data
0° Tensile	Strength MPa	ISO527-5	1080
	Modulus GPa		41.1
0° Compress	Strength MPa	ISO14126	825
	Modulus GPa		47
90° Tensile	Strength MPa	ISO527-5	65.2
	Modulus GPa		14.5
90° Compress	Strength MPa	ISO14126	194
	Modulus GPa		14.4
Shear	Strength MPa	ISO14129	51.8
	Modulus GPa		3.99



## TCR Multi-Axial Fabrics Composites Performance Testing Data

### Biaxial EBX808(+45/-45)EP Laminated Sheet

Testing Item		Testing Standard	Testing Data
Tensile	Strength MPa	ISO527-5	702
	Modulus GPa		31.5
Compress	Strength MPa	ISO14126	448
	Modulus GPa		28
Shear	Strength MPa	ISO14129	48.3
	Modulus GPa		3.98



## TCR Multi-Axial Fabrics Composites Performance Testing Data

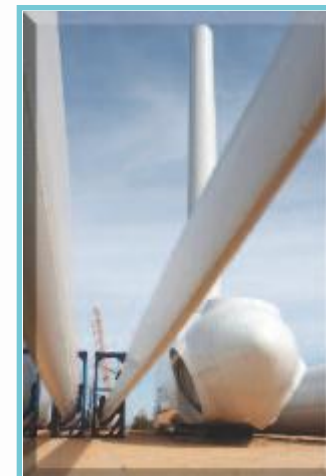
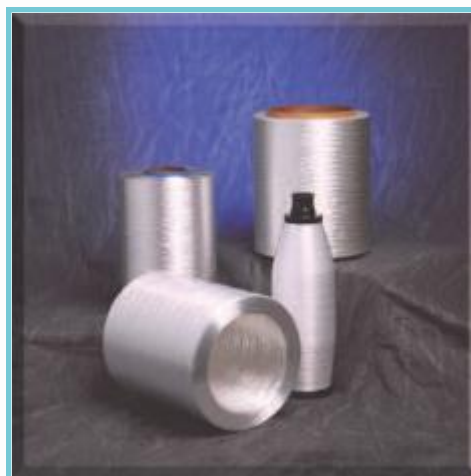
### Triaxial ETL1215(0/+45/-45)EP Laminated Sheet

Testing Item		Testing Standard	Testing Data
0° Tensile	Strength MPa	ISO527-5	812
	Modulus GPa		33
0° Compress	Strength MPa	ISO14126	630
	Modulus GPa		33.8
90° Tensile	Strength MPa	ISO527-5	138
	Modulus GPa		14.2
90° Compress	Strength MPa	ISO14126	203
	Modulus GPa		16.2
Shear	Strength MPa	ISO14129	153
	Modulus GPa		6.67





# S-1 HM™ High Performance Fiberglass





S-1 HM™

High Performance Fiberglass

The Cooperation between AGY & CTG



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中国中材

泰山玻璃纤维有限公司  
Taishan Fiberglass Inc.



# S-1 HM™ High Performance Fiberglass

## S-1 HM™ Rovings Features and Benefits

1

**The highest tensile modulus glass fiber available-90GPa**

2

**Proprietary glass formulation designed to maximize performance properties while allowing for high volume, economical manufacture**

3

**Sizing chemistries for compatibility with epoxy and polyester resins**

4

**Direct roving product form tailored for conversion to unidirectional fabrics and prepregs and multi-axial fabrics**

5

**Boron-free and environmentally friendly**



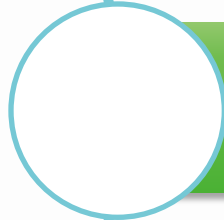
# S-1 HM™

## High Performance Fiberglass

### S-1 HM™ rovings performance vs. E-glass



**20% higher tensile modulus longer blades with no weight increase or weight reduction at same length**



**50% higher tensile strength higher loadings**



**10x higher fatigue improved reliability and lower total cost of ownership**



# S-1 HM™

## High Performance Fiberglass

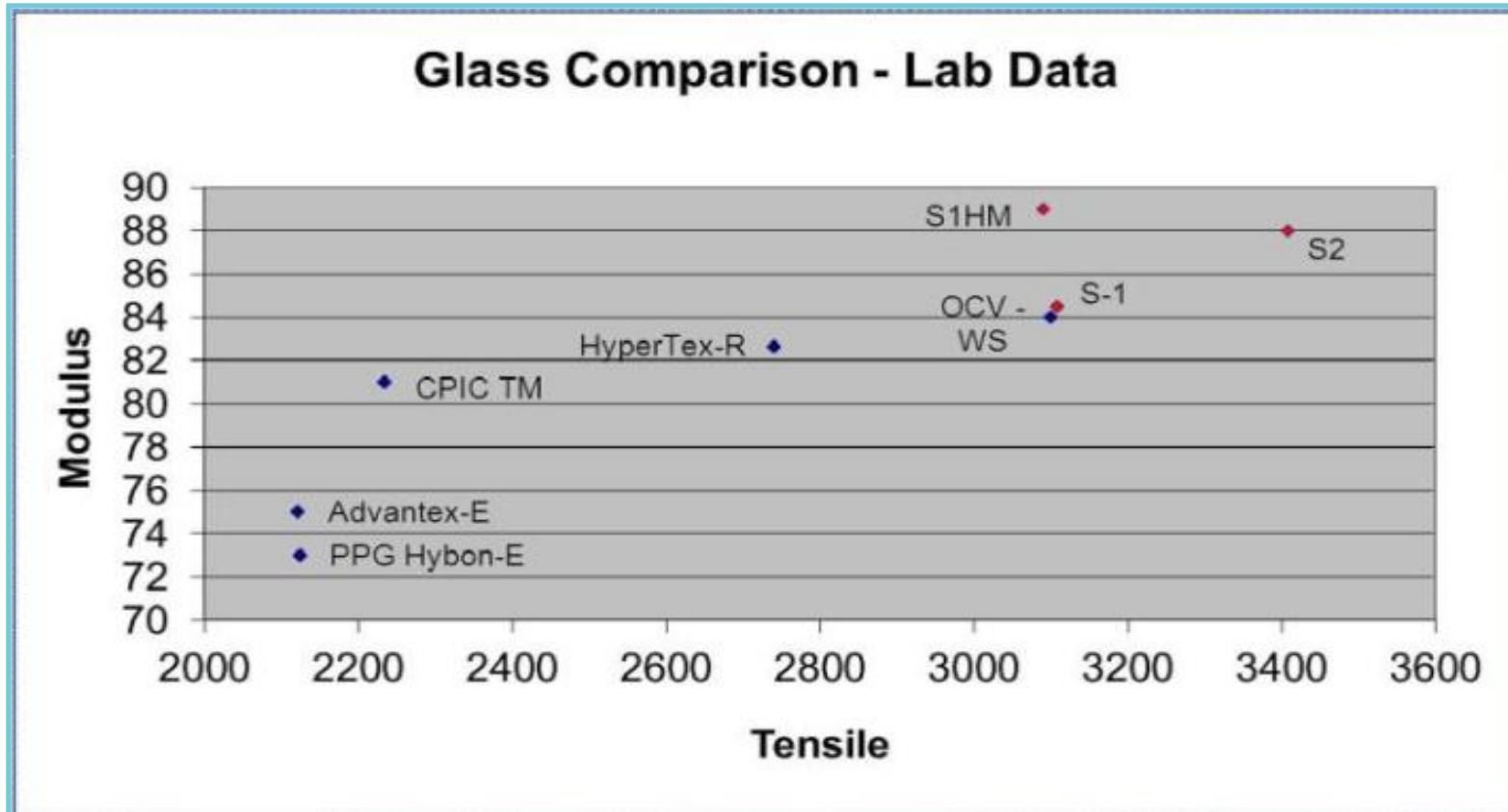
### S -1 HM™ Glass Properties

	AST M	Units	S-1 HM™ Glass	Typical R-Glass	Typical E-Glass
<b>Glass Strand Properties</b>					
Density		g/cc	2.55	2.57	2.58
Tensile Strength	D2343	MPa	3090	2700	2100
Specific Tensile Strength		10 <sup>3</sup> m	121	105	81
Tensile Modulus	D2343	GPa	90	83	73
Specific Tensile Modulus		10 <sup>3</sup> m	3.53	3.23	2.83
<b>UD Fabric Laminate Properties (60% FVF)</b>					
Tensile Strength	D3039	MPa	1230	1050	775
Tensile Modulus	D3039	GPa	51	47	40
Compressive Strength	D3410	MPa	850	720	600
Compressive Modulus	D3410	GPa	51	46	41
Flexural Strength	D790	MPa	1390	1260	1200



# S-1 HM™ High Performance Fiberglass

## S -1 HM™ Glass Properties



Data Resource: AGY



# S-1 HM™

## High Performance Fiberglass

### Prospection

**S-1 HM™ fibers, developed as a next generation of S-Series® glass products, offers the highest mechanical properties while meeting the economic needs for the reinforcement market. AGY has a long history standing track record of meeting the demands for challenging customer requirements with unique and dynamic modifications of glass chemistries while CTG/Taishan Fiberglass Inc. brings its innovation, experience and skills in the large scale manufacture of glass fiber rovings.**

**We expect that our S-1 HM™ fibers could provide the wider option and superior service for the development of wind energy industry.**

**Thank You!**