



INNOVATIONS FOR LIVING™

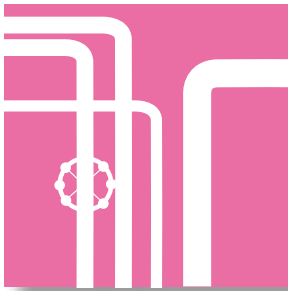
COMPOSITE SOLUTIONS BUSINESS

# Composite Pipes

A collage of four images related to composite pipes. The top-left image shows a stack of white composite pipes. The top-right image shows a large white composite pipe with a truck inside it. The bottom-left image shows a close-up of a green composite pipe. The bottom-right image shows a close-up of a green composite pipe. The text "Transforming the World with Advanced Solutions" is overlaid in white on a dark horizontal band across the center of the collage.

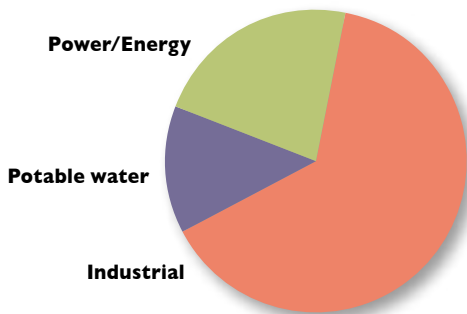
**Transforming the World  
with Advanced Solutions**

# PIPE MARKET\*

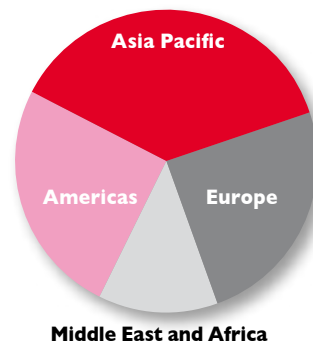


Pipes are used to carry potable water, sewage water, oil, gas, and other chemicals. It is a growing market, especially in Eastern Europe and the Middle East because of population increases and urbanization. Concrete, cast iron, steel and thermoplastic are the most common materials currently used to make pipes. However, Glass Reinforced Plastic is growing rapidly in its market share. GRP pipes can be made by Centrifugal Casting, Filament Winding and Continuous Filament Winding processes.

GLOBAL PIPE MARKET BY END USE APPLICATION (vol.)



GLOBAL PIPE MARKET BY REGION (vol.)

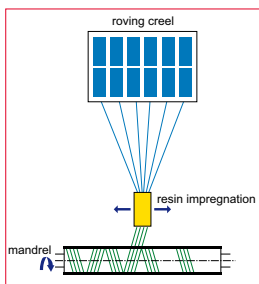


\*2011 | Owens Corning proprietary database

## PIPE MAKING PROCESSES

### FILAMENT WINDING

There are two basic methods of filament winding. In one method, helical winding, the resin-impregnated continuous fibre rovings are wound at a controlled helix angle in each selected direction on a removable mandrel.



The other method, continuous filament winding, allows one to produce continuous pipes with adjustable diameters from DN80 to DN4000 with chopped fibers, circumferential wrapped fibers and sand to

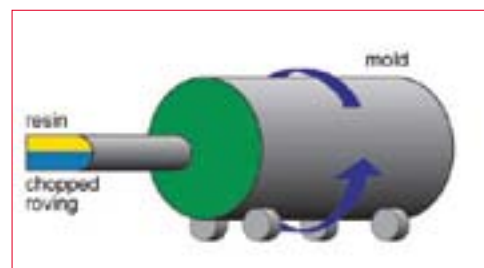
provide the required pipe strength and stiffness.

Most pipes made by either of the two methods have an inner layer consisting of a smooth resin-rich surface reinforced with veil made of glass to provide maximum abrasion, corrosion resistance and smoothness to guarantee lower head losses than traditional materials.

### CENTRIFUGAL CASTING

Multi-End rovings going through a chopper and resin are sprayed into a rotating, cylindrical, metal mold. The resin impregnates the reinforcement under the effect of the centrifugal force and forms, after polymerization, a cylindrical structure.

Centrifugal casting is particularly well suited for producing structures with large diameters.



# MARKET NEEDS

- Reliable and fast processing
- Cost-effective performance
  - . Work pressure resistance vs. thickness
  - . Material savings
  - . Smoother exterior finish
  - . Enhanced long-term durability
  - . Very good corrosion resistance in acidic environments
  - . Very good stress-corrosion resistance under constant stress
- Leads to easy to install/transport products
- Enables production of pipes, fittings and accessories





# OWENS CORNING PROVIDES A COMPREHENSIVE RANGE OF REINFORCEMENT PRODUCTS FOR PIPE MAKING

## SINGLE-END ROVINGS



*Our Advantex® glass single-end rovings contribute to superior mechanical properties for pipes made with a continuous process. They enhance pipe life-time in chemical and sewage pipe markets.*

NA	LA	EMEA	AP	PRODUCT	RESIN COMPATIBILITY			
					EPOXY	POLYESTER	VINYLESTER	PHENOLIC
●	●		●	I58B	●			○
●	●	●	●	R25H*	○	●	●	
●	●	●	●	SE1200*	○	●	○	○
●	●		●	366	○	●	●	
●	●		●	SE2348	●			
●	●		●	SE2350	●			○
●	●	●	●	SE1500	●			
		● (russia only)		I17A	○	○	○	
		● (russia only)		202	●	○	○	
●				346	●			
●			●	SE2307	●			

NA : North America. LA : Latin America. EMEA : Europe Middle East Africa. AP : Asia Pacific

## MULTI-END ROVINGS



*Multi-End rovings help easy processing and provides high mechanical properties before and after ageing. They are compatible with a wide range of resin systems such as polyester and vinylester for highly demanding applications such as pipes or tanks for wastewater treatment and chemical outlets.*

\* Several Owens Corning SE and ME rovings are also safe for use in pipes for potable water distribution.

APPLICATION	AMERICAS	EUROPE	ASIA
Centrifugal Casting		P219*	
Chop and Drop	495*	P246 495*	P246 495*

# NON-WOVENS



*Owens Corning Technologies provides a wide variety of ECR and C-glass veils for filament winding. The mandrel can be covered with a veil for an inner/external corrosion resistant and/or aesthetic surface.*

M524 RANGE	STYRENE SOLUBILITY	FIBRE TYPE	FIBRE DIAMETER	FILAMENT WINDING POLYESTER	FILAMENT WINDING EPOXY
ECR50S - ECR30S	v. sol	ECR	13	●	
ECR20A- ECR25A - ECR30A	slowly sol	ECR	13	●	●
ECR70A/3 - ECR50A/3	slowly sol	ECR	13	●	●
ECR50H/3 - ECR30H/3	slowly sol	ECR	13		●
C64	v. sol	C	12.5	●	
C33	slowly sol	C	12.5		●

We have in house capability to slit out C-glass veils in width of 50mm bandage upwards and E-CR glass veils in width of 35mm bandage upwards.

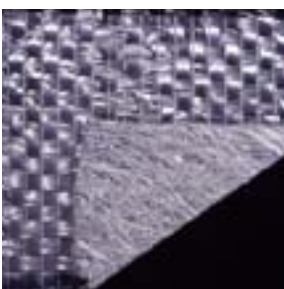
## ■ E-CR glass veils:

Advantex® glass wet use veils provide excellent corrosion resistance. 20 up to 70 g/m<sup>2</sup> veil types are suitable for both continuous and discontinuous filament winding, glass reinforced plastic and glass reinforced epoxy pipes.

## ■ C-glass veils:

Long fibre highly drapable dry use veils with excellent wet out capability and conformability. Ideally suited for the fixture and fitting market where a resin rich surface is required to protect the outside of the pipe from Ultra Violet and chemical attack.

# FABRIC SOLUTIONS



*Several products can be used for these applications, mainly for reinforcing the GRP pipes in order to improve the pressure resistance or for the fitting joints.*

## Product types

- **Woven** : Balanced/Unbalanced Woven Roving, Tapes and UD Tapes ( 0° or 90°)
- **Stitched**: Multiaxials, Unidirectionals, Woven Roving with Chopped Strand Mats

# ADVANTAGES OF GRP<sup>(1)</sup> PIPES VS. TRADITIONAL MATERIALS



- Light weight (approximately 1/10 of concrete pipes and 1/4 of steel pipes)
  - » lower transportation and installation costs
- Workability of the material on site with the use of simple tools
  - » easy assembly and installation
- Longer pipes than with competing materials; no welding needed and fewer joints
  - » lower cost and easier installation
- Virtually impermeable
  - » superior leak resistance
- Smoothness of the internal wall, minimized pressure drops and no formation of deposits
  - » higher transport rate
- Better hydraulic performance than steel, ductile iron and concrete
  - » more efficient carrier
- Corrosion resistance. No protection such as coating, painting or cathode are needed
  - » lower cost and better maintenance
- With Advantex<sup>®</sup> glass, even more resistance to corrosion by strong diluted acids such as H<sub>2</sub>SO<sub>4</sub>, compared to E-glass
- Better stress- and strain-corrosion resistance (to acids) than traditional E-glass reinforced GRP pipes
  - » “Install it and forget it”
- Low thermal conductivity
  - » reduces condensation problems and resulting moisture related corrosion
- Hazen Williams flow coefficient is 150, due to low friction losses
  - » less pumping energy is required compared to steel and concrete pipes or the same flow rates can be ensured using smaller diameters

(1) Glass Reinforced Plastic



# THE ADVANTAGES OF THE ADVANTEX<sup>®</sup> GLASS

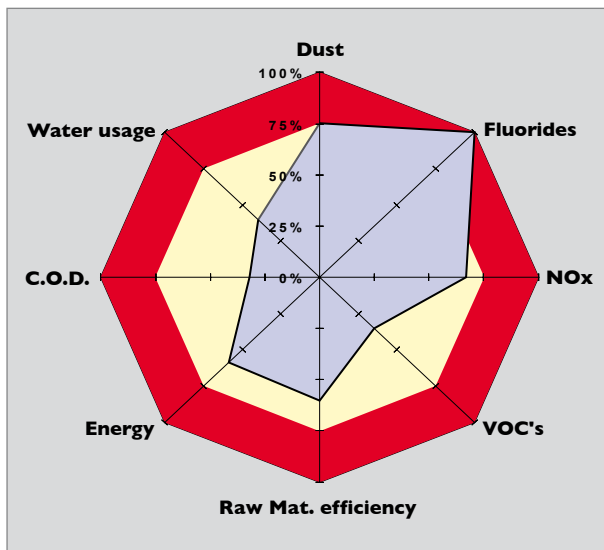
- Advantex<sup>®</sup> glass offers the unique attributes of being both a boron free E-glass and E-CR glass in accordance with ASTM D578 and ISO 2078.
- Performing better than traditional E-glass particularly in acids and water and to a certain extent in alkaline solutions.
- Allowing material savings versus E-glass.
- With a excellent resistance to high temperature (higher softening-point temperature compared to standard E-glass).

## Advantex<sup>®</sup> glass has

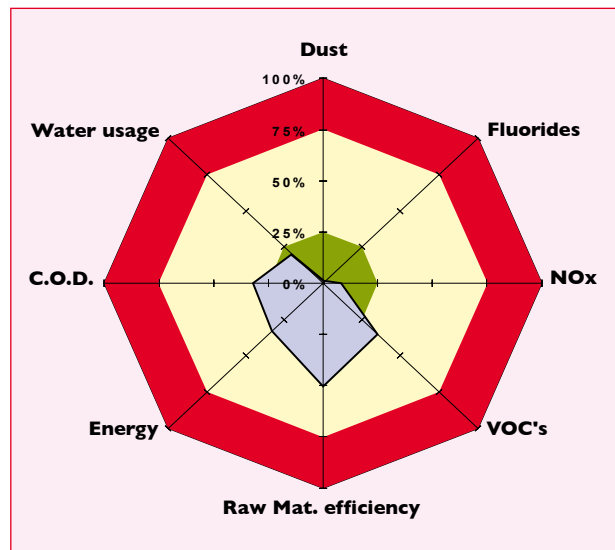
- Up to **54% higher** allowable strain in strain-corrosion testing in H<sub>2</sub>SO<sub>4</sub> vs. E-glass
- Up to **50 Years** life expectancy vs. 3 months using E-glass using FRP pultruded rods under stress-corrosion conditions in salt water
- Up to **50 Years** patented corrosion resistant E-CR glass meeting ASTM D578 and ISO 2078 standards for best glass type used in corrosive environments.

(Comparing to standard E glass: based on Claude Renaud, Owens Corning, 2008, Environmental Benefits of using Advantex<sup>®</sup> Glass Fibers as Reinforcements in Composite Materials, Mark Greenwood, Owens Corning, 2002, Stress Corrosion Lab Testing, NSL Analytical Services Inc, 2012, test report (NSL Lab No: 1216768), Cleveland, Ohio)

Traditional E-glass



Boron and fluorine-free OC<sup>®</sup> Advantex<sup>®</sup> E-CR glass



The Boron and fluorine-free OC<sup>®</sup> Advantex<sup>®</sup> E-CR glass helped Owens Corning improve our own operational performance with energy reductions and reductions of ingredients such as boron and fluorine.

The above comparison data is limited to Owens Corning own production facilities and shows an internal, Owens Corning E-glass to Owens Corning new Advantex<sup>®</sup> process comparison and is not comparing to other's E-glass production. It was typical for Owens Corning plant conversions. Actual results vary from plant to plant.

# SUPPORTING OUR CUSTOMERS WHERE THE MARKET GROWS

- Supplying Materials Globally
- Advantex® E-CR glass available around the world
- Fabrics global manufacturing and science platform delivering consistent solutions
- Matching global Thermoplastics customer locations
- Serving BRIC Countries
- Supporting Innovation and New Technologies



INNOVATIONS FOR LIVING™

- Headquartered in Toledo, Ohio, United States
- Operates in more than 30 plants in 15 countries
- 6 science and technology centers on 3 continents: Apeldoorn, NL, Chambéry, FR, Granville, OH, Ibaraki, Japan, Shanghai China, Zele Belgium
- 2011 Sales: \$1.976 billion

[composites.owenscorning.com](http://composites.owenscorning.com)

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