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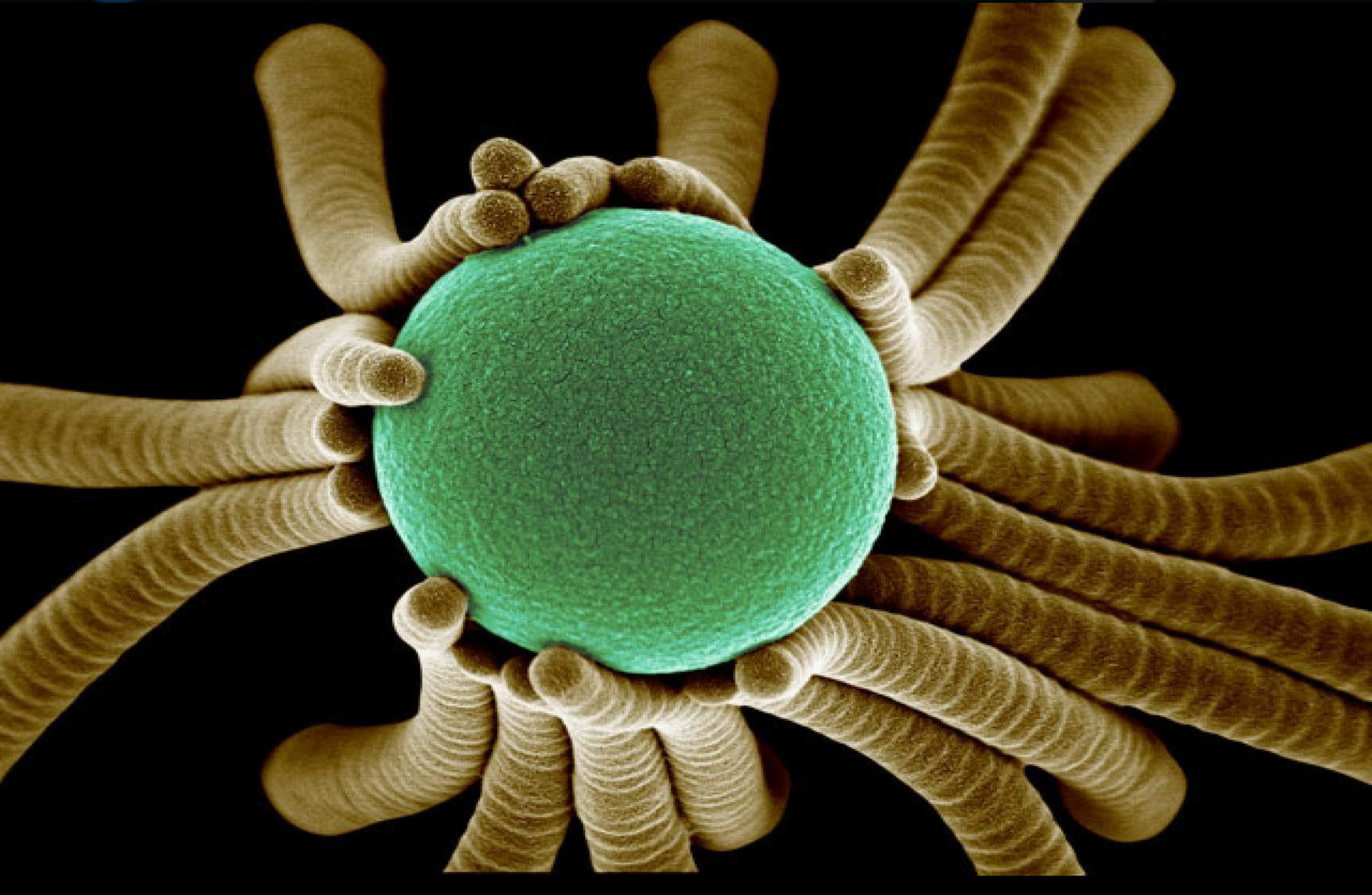
ADVANCED TECHNOLOGY RESINS

RESOLVING YOUR ENGINEERING CHALLENGES



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Resoltech Epoxy Resins

Pierre Calmon - Export director p.calmon@resoltech.com +33 673 41 35 46

Who are we?

- Created in 1996 by Luc Loriot who started formulating for the kayak & winsurf industry in the 80´s.
- Manufacturing close to Marseille, France & in Valencia, Spain for large batches.
- Developed over 800 systems with some very advanced polymers such as water based epoxy systems or fire resistant resins for the Airbus A380.
- Resins used in all fields: Marine, aerospace, transport, wind energy, civil engineering, sports & leisure, tooling..etc.
- **Excellent wetting properties and low toxicity (NO CMR) are common factors to all Resoltech products**
- **New developments of water based and Bio based resins**

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FORMULATION AND PRODUCTION OF EPOXY RESIN

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FENWICK

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RESOLVING YOU

Polyester cheaper than Epoxy?

Study case of 70 foot interceptor

CHANTIER NAVAL HESARO S.A

Interceptor 45'

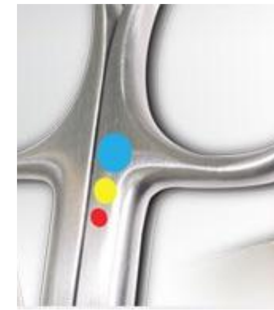
Why use epoxy?

- **Case:** initially planned in polyester iso w/ multiaxial glass fibre, the calculations showed that the boat could not reach 70 knots AND have a decent range due to the weight of the hull: 4920 Kg total with 1970 Kg. fibre and 2950 Kg polyester resin.

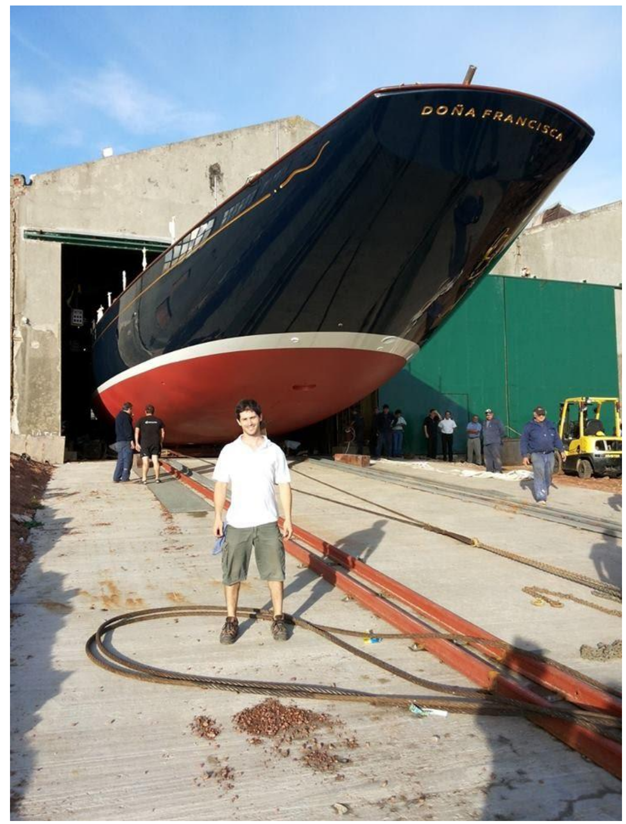
- **Solution**: The structural calculations reviewed showed that switching to epoxy enabled to reduce the hull weight by nearly 20%: 3985kg with 2230 Kg. fibre & 1755 Kg epoxy resin.

- This reduction of weight enabled to reduce the engines size and therefore the fuel tank size. The economy done on the engines out-passed by far the extra cost of the resin, resulting in a boat matching it´s specifications and overall cheaper than if it had been manufactured in polyester resin.

PRODUCTS RANGE



- Laminating resins
- Infusion resins
- High temperature resins
- Gelcoats
- Adhesives
- Fire protection
- Epoxy foams
- Civil engineering & floors
- Casting resins
- Food Grade resins



RESOLTECH SYSTEMS CODES

Example *1050 lamination & Infusion resin*

1	*0*	*5*	*0*	
lamination	Product number		Resin	Version

Type of application
1:liquid resin for lamination, infusion, RTM..etc..)
2: Casting resin
3: Adhesives
4: coating/floors/industrial
5: vinylester
6: modeling paste
7: Epoxy gelcoats
8. Fillers
9: polyesters

0 = RESIN
Other than 0 = hardeners

3 = slowest hardener
9= fastest hardener

T = tixotropic version
S = accelerated version
W = water bound
L = Slow
IND = industrial version

All resins are sold in “kits” composed of the exact amount of hardener for the resin quantity (1,5,25,200, 1000 kg)

Curing & Postcuring (basic rules)

- Gel time = Exothermic peak moment = just after the gel it is possible to cure with elevated temperatures to cure faster.

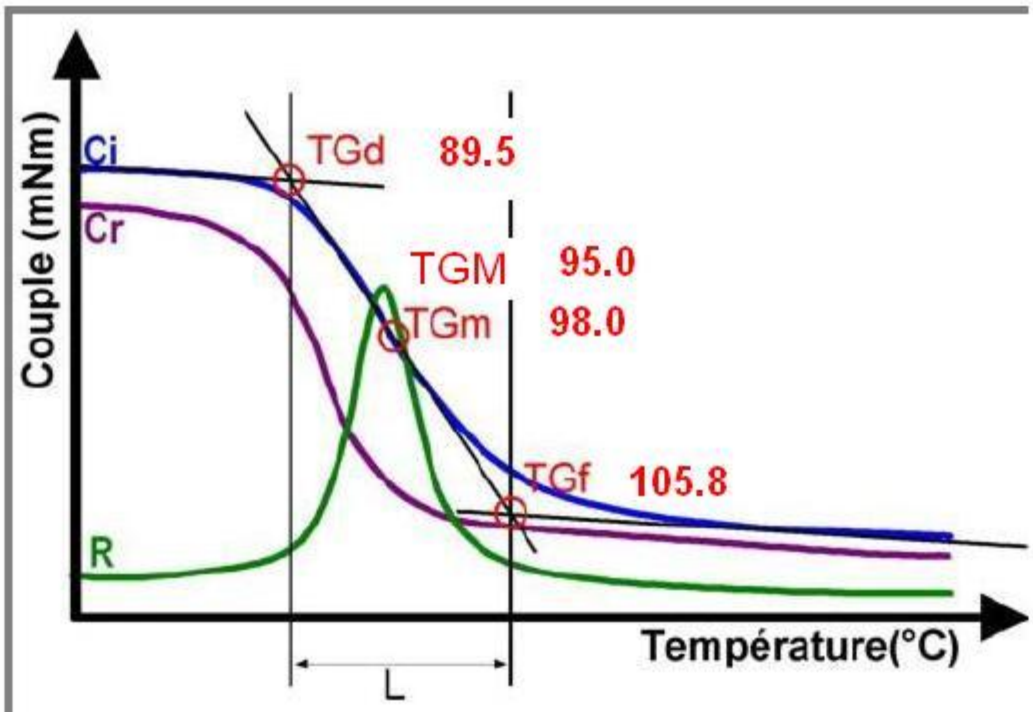
- Epoxy resin laminated at room temperature will obtain max. 20 to 30ºC of Tg above the room temperature: if you laminate at 23ºC, 24h later you can expect approx 40ºC TG. (Why use a 90ºC TG system if you cannot postcure the part?)

- If you cannot postcure the part, use a resin with good room temperature cross-linking properties (1020, 1050, 1070)

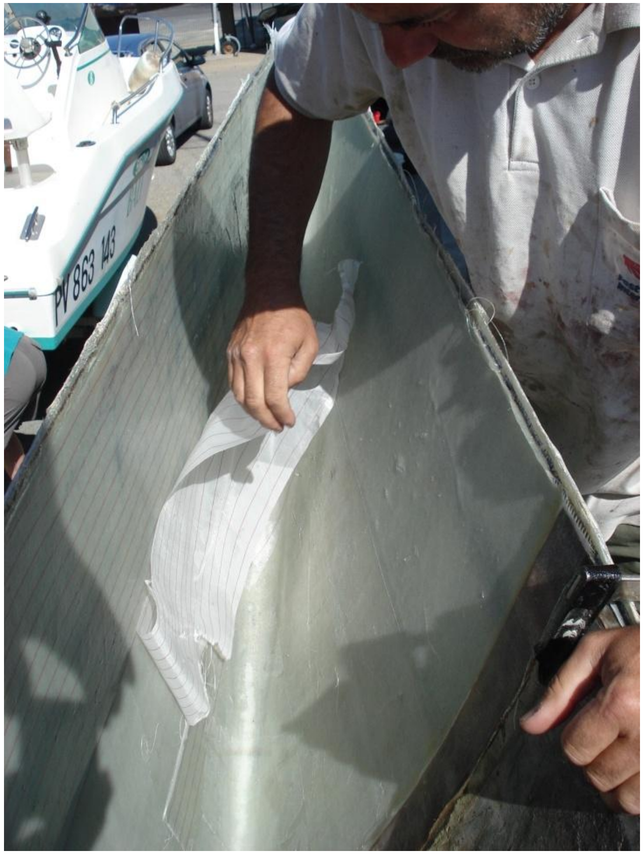
- Post curing schedules: try to keep the part/mould below the current Tg of the part.

- Ramps: 0,2 to 0,5 ºC/ then 2h dwell times every 20ºC from 40ºC onwards.

TG or Glass Transition Temperature (DMA)



Laminating Resins



1020

- **Wood epoxy/ All purpose system**
- 10% elongation
- Not sensitive to humid environments during application
- Pot life: 15 min. to 8h
- TG max: 65 °C
- For room temperature applications
- High Elongation to break. .

1200

- **High performance laminating resin reactive diluent free**
- Pot life: 15 min. to 8h40 hardeners can be mixed together to adjust working time.
- TG 86 °C to 130 °C
- Mould release at room temperature with 1204 & 1208 hardeners.
- Needs postcure to obtain final TG
- For tools & performance parts with high mechanical properties.
- Germanisher Lloyds approved

1050

Resoltech´s most sold multipurpose room temperature cure system

- Low viscosity, excellent wetting properties and interlaminar strength. Very good fatigue & microfissuration resistance.
- Pot life: 10 min. to 14 hours.
- Lowest viscosity 14h pot life for **infusion hardener**
- Medium viscosity **standard and fast hardeners** for wet layup.
- TG 63ºC to 75 °C
- Mould release at room temp.
- Obtains 90% of mechanical characteristics @ room temp – excellent for very large infusion applications.

1070

- **Resin with very good surface aspect, UV resistant**.
- Can be over coated with polyester.
- Pot life 7h or 20 min.
- 3h sandable with 1077 new hardener
- TG 75 °C
- Mould release at room temp.
- For all aesthetic structural applications & topcoats. UV stable for outdoors applications

1080S

- **Highest Module resin for highest rigidity & low weight requirements**
- Low viscosity, maybe infused or hand-laminated
- Pot life 20 min, 1h30 or 4h30
- TG 110 °C
- **Mould release at room temp**.
- Needs postcure @ 60 °C to obtain maximum properties

1070 ECO

- **37% Bio sourced resin:** Epichlorydrine in Bisphenol A reaction is bio-based, and reactive diluant is plant based

- **Resin with very good surface aspect, UV resistant**.
- Can be over coated with polyester.
- Pot life 28 min

- TG 74 °C
- Mould release at room temp.

- For all aesthetic structural applications & topcoats. UV stable for outdoors applications

Infusion Resins

1800

- Very low viscosity (145 to 290 mPa.s)
- Pot life 50 min. to 2h.
- TG: 130 °C w/ 1805 hardener
- TG: 85 °C w/ 1808 hardener
- 1800/1805 needs post-cure
- 1800/1808 maybe released from mould without post-cure

.

1050-1053

- Extra low Viscosity of 250 mPa.s.
- 14 h Pot life on 100 gr.
- 2h30- 3h pot life on 50 kg. mix
- TG: 75 °C
- Room temp. cure & release for very large parts
- 90% of mechanical characteristics @ room temp
- The “safest” infusion epoxy resin for large infusions

High Temperature Systems

High temperature Systems

Infusion resins

- 1800 130 °C TG - 2h pot life – postcure 60 °C - vis. 250 cps
- HTG 160 160 °C TG - 2h20 pot life – postcure 200 °C - vis. 235 cps
- HTG 180 180 °C TG - 3h20 pot life – postcure 200 °C - vis. 285 cps
- HTG 200 200 °C TG - 4h40 pot life – postcure 200 °C - vis. 375 cps
- HTG 240 240 °C TG - 6h pot life – postcure 200 °C - vis. 594 cps
- CE 15 340ºC Monocomponent Cyanate ester, hardens @ 150ºC
- CE 400 400ºC Monocomponent, Cyanate Ester hardens @165ºC

Lamination Resins

- 1200 130 °C TG
- HTGL 160 160ºC TG
- HTGL 210 210 °C TG
- CE 300 300ºC TG
- CE 400 400ºC TG

Gelcoats

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Polyester & Vinylester (epoxy compatible) Gelcoats

9040 PX

- Polyester Gelcoat compatible epoxy
- Clear color
- All RAL pigments available
- TG 65 ºC
- For parts only
- **Good UV resistance**

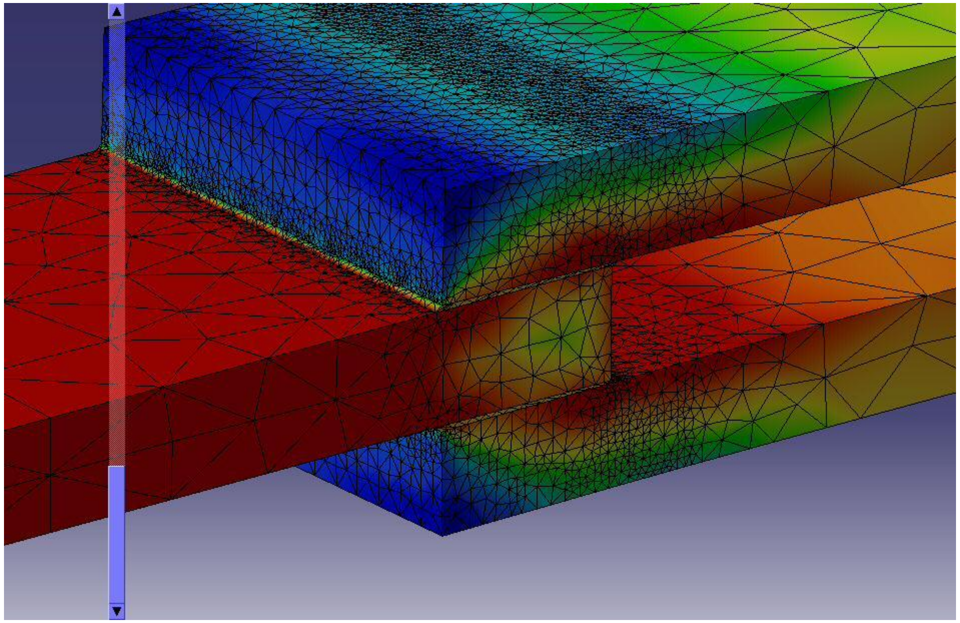
VI 5090 & VI5070

- Vinylester Gelcoat compatible epoxy
- Clear color
- All RAL pigments available
- TG 105ºC and 130ºC
- High chemical resistance
- For tooling and parts
- **Good water resistance**

Epoxy Gelcoats

- **7060** : UV resistant epoxy gelcoat TG 70°C
- **7080 HC**: Epoxy gelcoat & topcoat for fuel tanks
- **7090**: High temperature tooling gelcoats for pre-preg TG 140°C
- **2060 ALU GC** Aluminium filled gelcoat for heating& solid surface tools
- **GC-HTG 180**: 180°C tooling gelcoat for HTG series resins
- **GC-HTG 210**: 210°C tooling gelcoat for HTG series resins
- **2010 FGCS** Self extinguishing gelcoat

Adhesives



- **3040**: **Structural adhesive** for sealing in any weather curing conditions for Civil engineering & price sensitive structural applications **Fast curing & economical.**
- **3050CT**: **High traction/shear structural adhesive** (310 kg/cm^2). High tack, 4h pot life
- **3300**: **Under water** adhesive
- **3030AL**: **Food grade** certified adhesive
- **3350:** Latest technology structural adhesive, grease like consistency, very easy to apply. **THE all purpose adhesive**
- **3350 HP**: **Low density (0,7)** core bonding adhesive
- **3350 XT**: **Extra tixotropic** version of the 3350 adhesive
- **3350 L**: **Low viscosity** version for brush application

Fillers / Highbuilds / Paints

8030 **Lightweight filler** (0,70) for thick applications up to 30mm without sagging (grey color).

8050 **Fast Curing 0,8 density filler. (The Future)**

3010T Solvented **primer/high build**.(white). Last coat before paint.

May be sprayed or rolled.

Easy to sand.

Also used as part of anti osmosis treatments and anticorrosion applications.

8010 W: **Water based epoxy spraable filler** (currently beta tested).

4030W: **Water based epoxy paint** for interior applications & PU or Epoxy tooling blocks finishin. Satin or high gloss finishes

.

Casting resins

- **2010**: Casting resin available in over 10 versions: dielectric, self-extinguishable, underwater, 0,6 density.
  All version with very low exothermic peak.

- **2060ALU25**: Aluminum filled casting resin for thermoforming & rapid prototyping. TG 110ºC Maybe laminated.

- **2090**: High elongation epoxy caulking.

- **1450 ALU:** Aluminum filled casting resin for thermoforming & rapid prototyping. TG 150ºC

- **WWA:** Transparent casting resin (leds, art…etc..)

Fire resistant
Epoxy systems

- **1090 FR:** Self extinguishing **laminating & filament winding** resin with FAR 25.853 certification as well as Airbus smotox certifications.

- **2010 FCI**: **Casting, self levelling**, self extinguishing epoxy resin with IMO-SOLA 2000 certification.

- **2010FGCS**: Self extinguishing **Gelcoat**, IMO SOLAS 2000. Horizontal, vertical and overhead application tested.

- **2080MF40**: Self extinguishing **epoxy foaming** resin.

- **8230FR** Self extinguishing honeycomb edging bordering paste & adhesive putty

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RESOLVING YOUR ENGINEERING CHALLENGES

Epoxy Foaming systems

- **2080M17**: 170 kg/m3 casting epoxy foaming resin (does not need postcure)
- **2080M25**: 250 kg/m3 casting epoxy foaming resin (does not need postcure)
- **2080M40**: 400 kg/m3 casting epoxy foaming resin (does not need postcure)
- **2080MF40**: 400 kg/m3 self extinguishing casting epoxy foaming resin (does not need postcure) UL94 V0
- **3080 ECO**: bio based fast curing 350 kg/m3

Civil engineering

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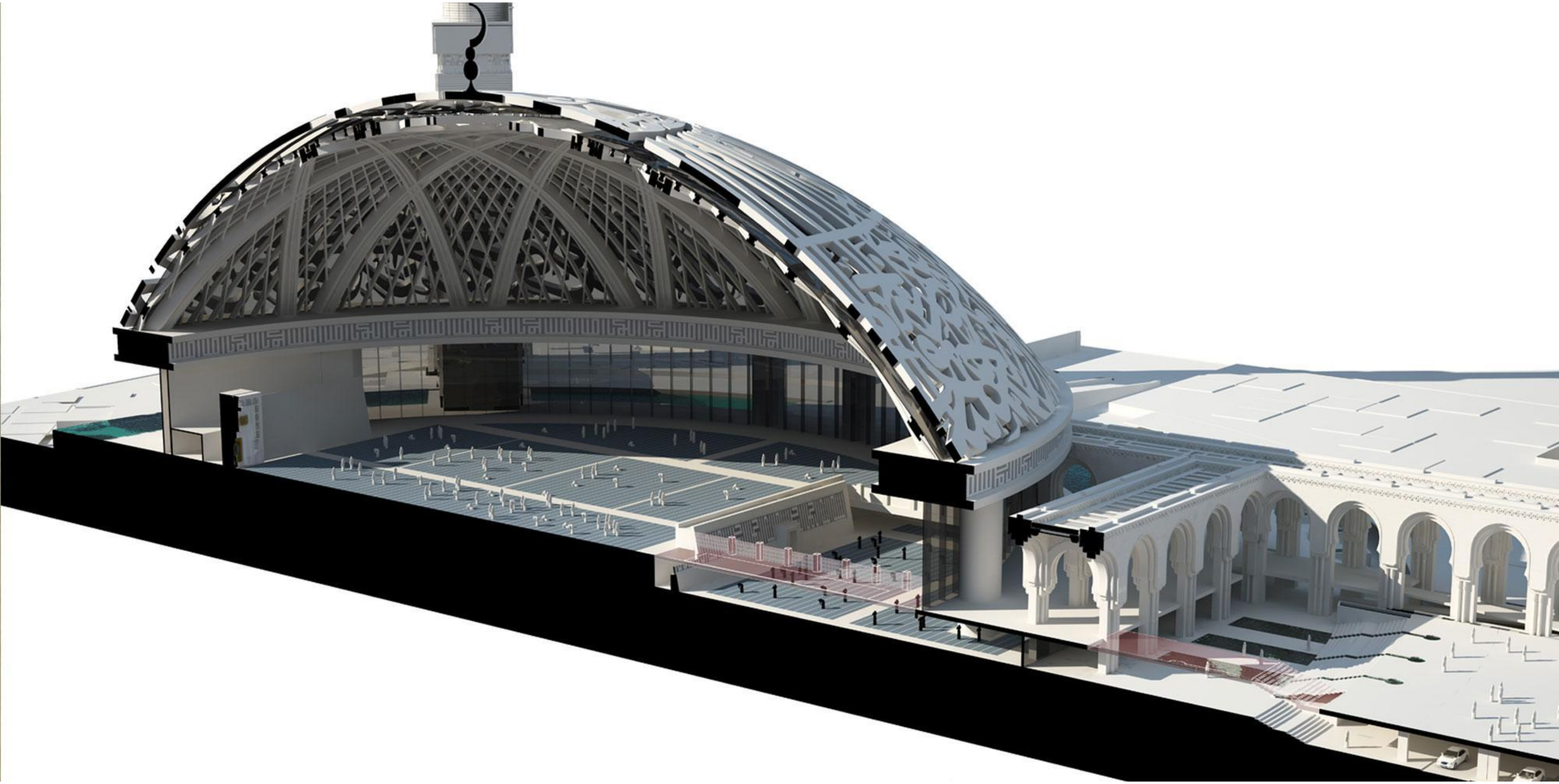
RESOLVING YOUR ENGINEERING CHALLENGES



- **1010AD**: epoxy primer & floor coating system
- **1010/1014**: water based epoxy primer
- **4030W**: water based epoxy paint
- **3330:** Under water curing adhesive filler
- **3000T** Solvent based epoxy paint
- **VLC**: “3D transparent floors”

FOOD GRADE Systems

4070AL **EU** food grade certified topcoat & gelcoat
3030AL food grade certified adhesive
1020AL food grade certified laminating resin

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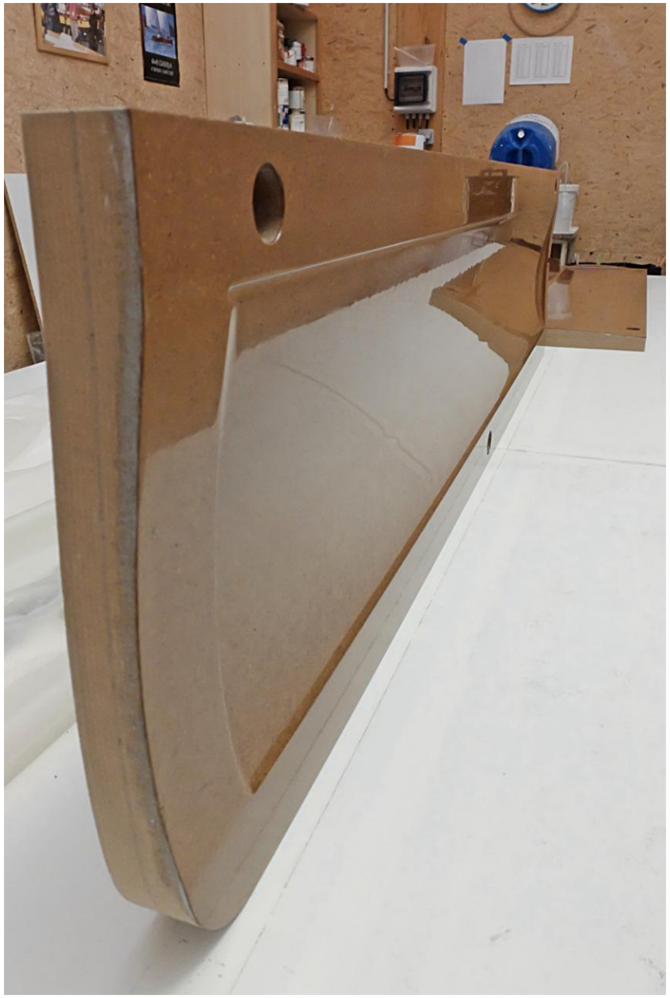
RESOLVING YOUR ENGINEERING CHALLENGES

Art & Decoration

- **WWA:** Transparent casting resin (leds…etc..)
- **VLS UV**: doming resin
- **1010**: water based resin for wood conservation

Water based epoxy systems

- **1010:** Primer and varnish for wood, MDF, PUR & epoxy tooling blocks
- **8010W**: Sprayable filler easy sanding for plugs & direct moulds.
- **4030W**: water based epoxy paint for:
  Boat bilges
  Direct moulds
  As gelcoat
  Factory floors



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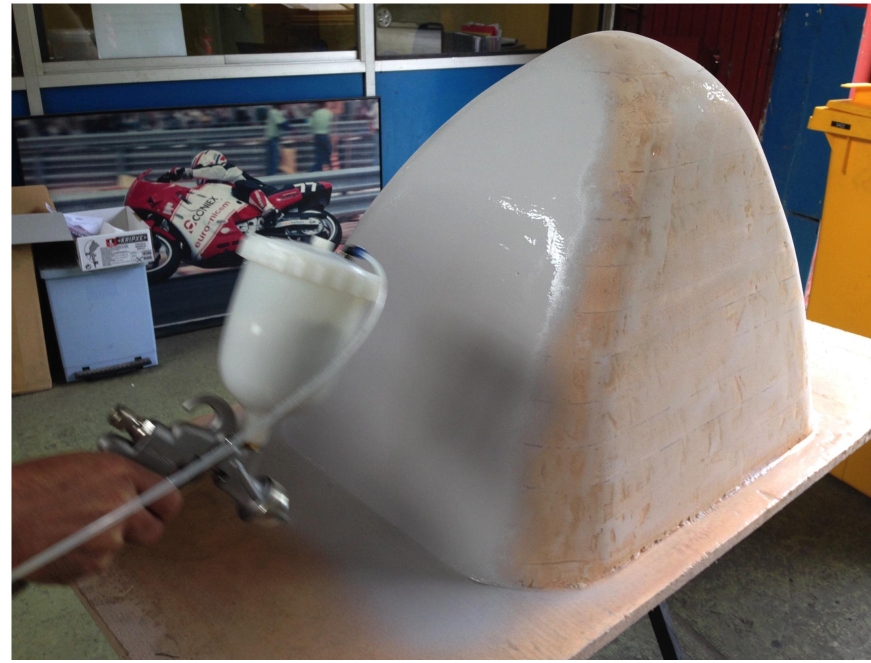
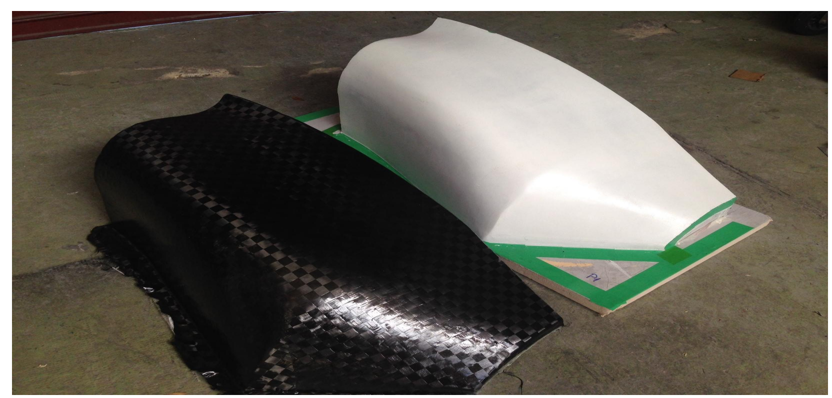
RESOLVING YOUR ENGINEERING CHALLENGES





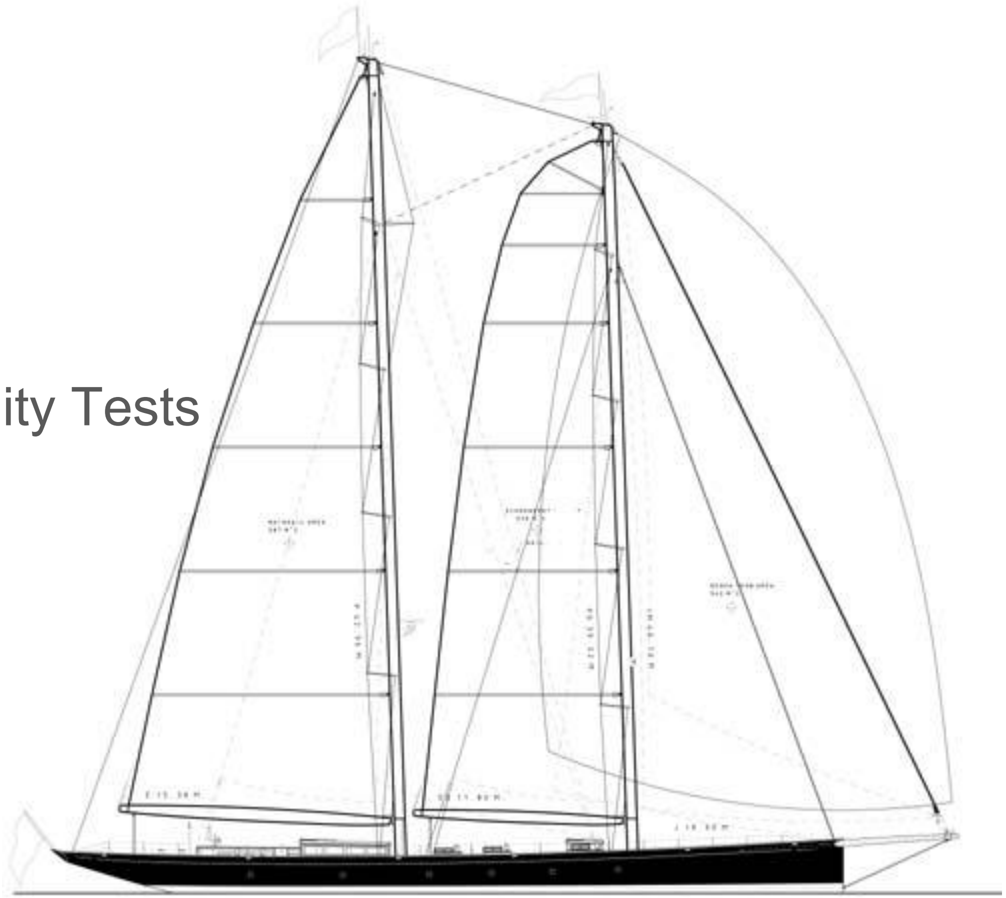
WHY CHOSE INFUSION IN BOAT BUILDING?

Study case on the largest yacht infused in carbon epoxy

Pierre Calmon
Resoltech Epoxy Resins
Composites Solutions

Agenda

1. Process Selection
2. Material Selection and Viability Tests
3. Infusion Process
4. Conclusions



1. PROCESS SELECTION

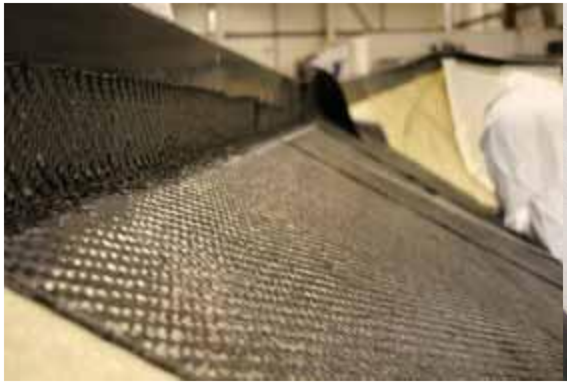
PREPREG

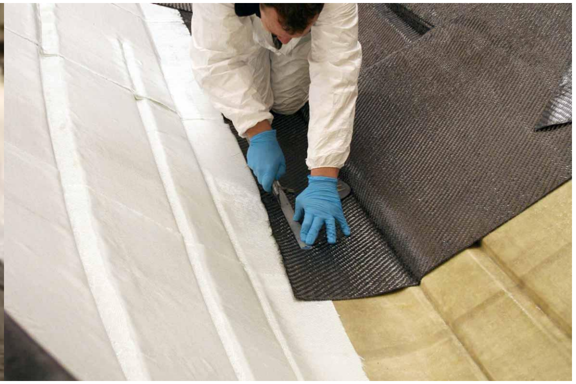
MAIN ADVANTAGES

✓ No liquids to handle
✓ Control percentage of resin

DISADVANTAGES

✓ Price
✓ Facilities (cold storage)
✓ Transport (cold premium)
✓ De-bulking needed





1. PROCESS SELECTION

SPRINT/Z-PREG/HexFit or similar

MAIN ADVANTAGES

✓ Not liquid handle
✓Control percentage of resin
✓Not debulking

DISADVANTAGES

✓ Price
✓Facilities (cold-room)
✓Transport
✓Oven needed
✓Needs placement of extra glass UD´s in order to help debulking on large parts

1. PROCESS SELECTION

WET LAY-UP + VACUUM

MAIN ADVANTAGES

✓ Price
✓ No special facilities required
✓No debulking

DISADVANTAGES

✓ Liquids to handle
✓ Health and safety issues
✓ Not percentage control
✓ Logistic nightmare in XL parts

1. PROCESS SELECTION

INFUSION

MAIN ADVANTAGES

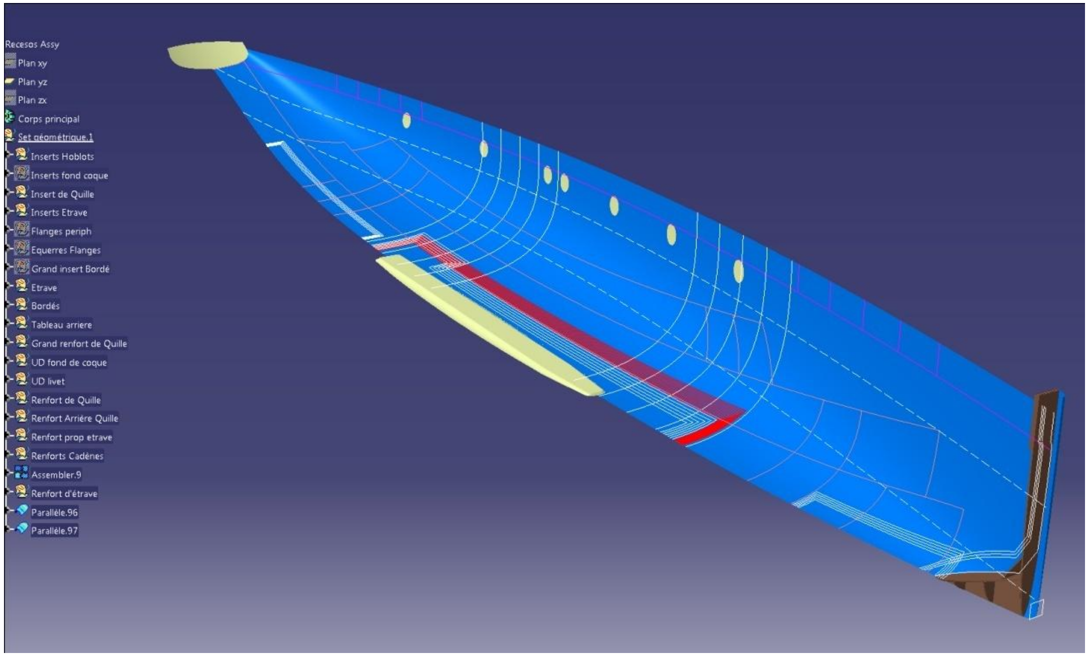
✓ Price
✓ No special facilities required
✓ No debulking
✓ NO COVs emission
✓ Resin percentage control
✓ No high temperature curing oven required

DISADVANTAGES

✓ Liquid handle
✓ High degree of precision needed for the infusion network
✓ Same price of testing & validation for one off or production boat.

2. MATERIAL SELECTION AND VIABILITY TESTS

GEL COAT, RESINS, REINFORCEMENTS



COMMENTS

2. MATERIAL SELECTION AND VIABILITY TESTS

Epoxy compatible
Vinylester gelcoat

Resoltech VI5090

2. MATERIAL SELECTION AND VIABILITY TESTS

GEL COAT, RESINS, REINFORCEMENTS

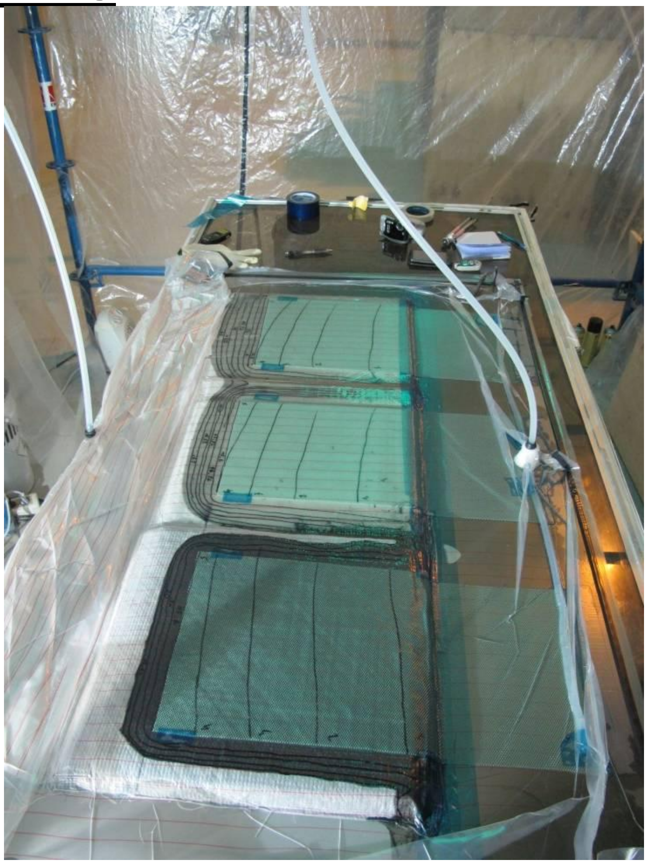
1. Process Selection
2. Material Selection and Viability Tests
   - Gel Coat
   - Resins
   - Reinforcements
   - Core
   - Adhesives
   - In mould test
3. Infusion Process
4. Conclusions

Calculation of resin flow speed on nominal layers with Resoltech 1050 resin (10h pot life & 205 mPas viscosity)

2. MATERIAL SELECTION AND VIABILITY TESTS

GEL COAT, RESINS, REINFORCEMENTS

Max thickness calculation



2. MATERIAL SELECTION AND VIABILITY TESTS

GEL COAT, RESINS, REINFORCEMENTS

Max distance of resin flow calculation

2. MATERIAL SELECTION AND VIABILITY TESTS

CORES AND ADHESIVES

1. Process Selection
2. Material Selection and Viability Tests
   - Gel Coat
   - Resins
   - Reinforcements
   - Core
   - Adhesives
   - In mould test
3. Infusion Process
4. Conclusions

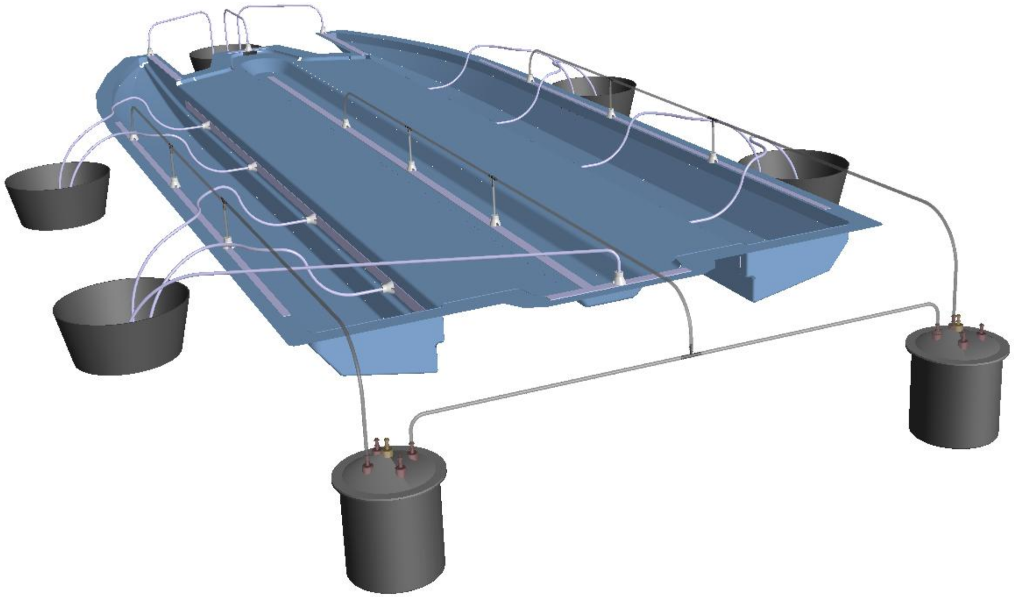
2. MATERIAL SELECTION AND VIABILITY TESTS

IN MOULD TESTS

Core bonding strategy

2. MATERIAL SELECTION AND VIABILITY TESTS

INFUSION NETWORK DEFINITION

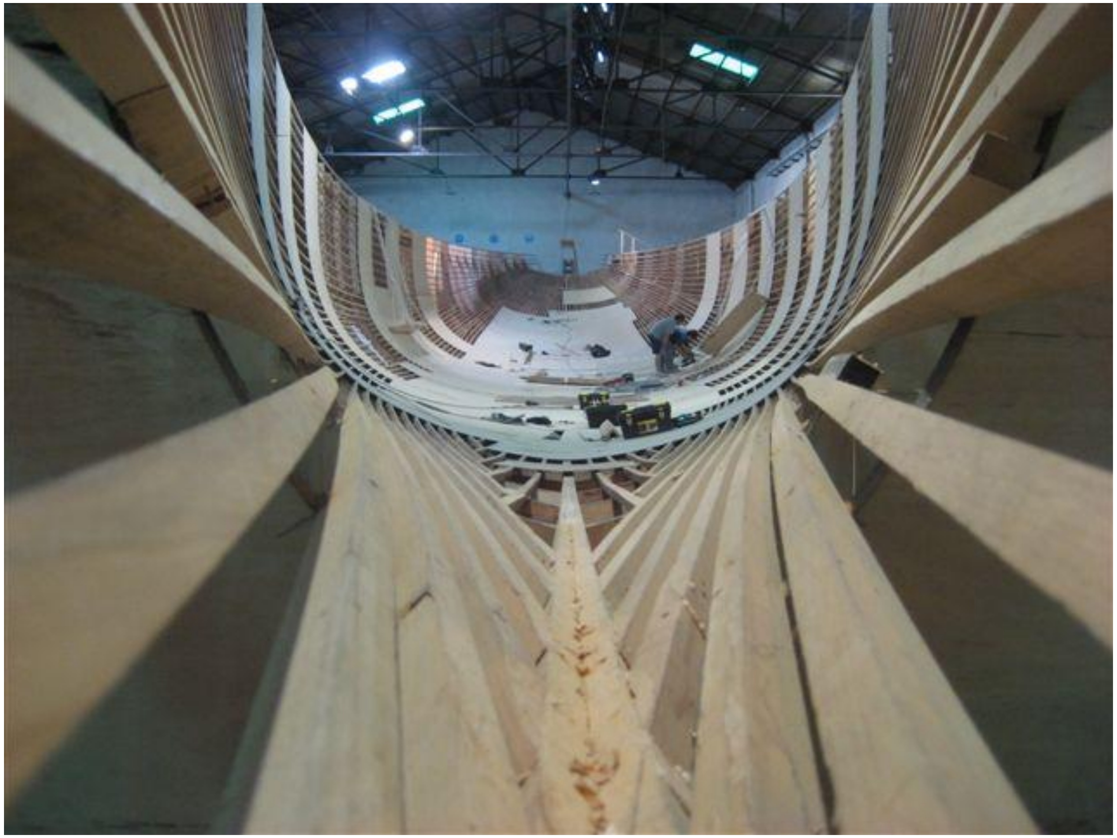


Design of the infusion strategy accoring to flow speed and range tests.

3. INFUSION PROCESS

MOULD PREPARATION

3. INFUSION PROCESS

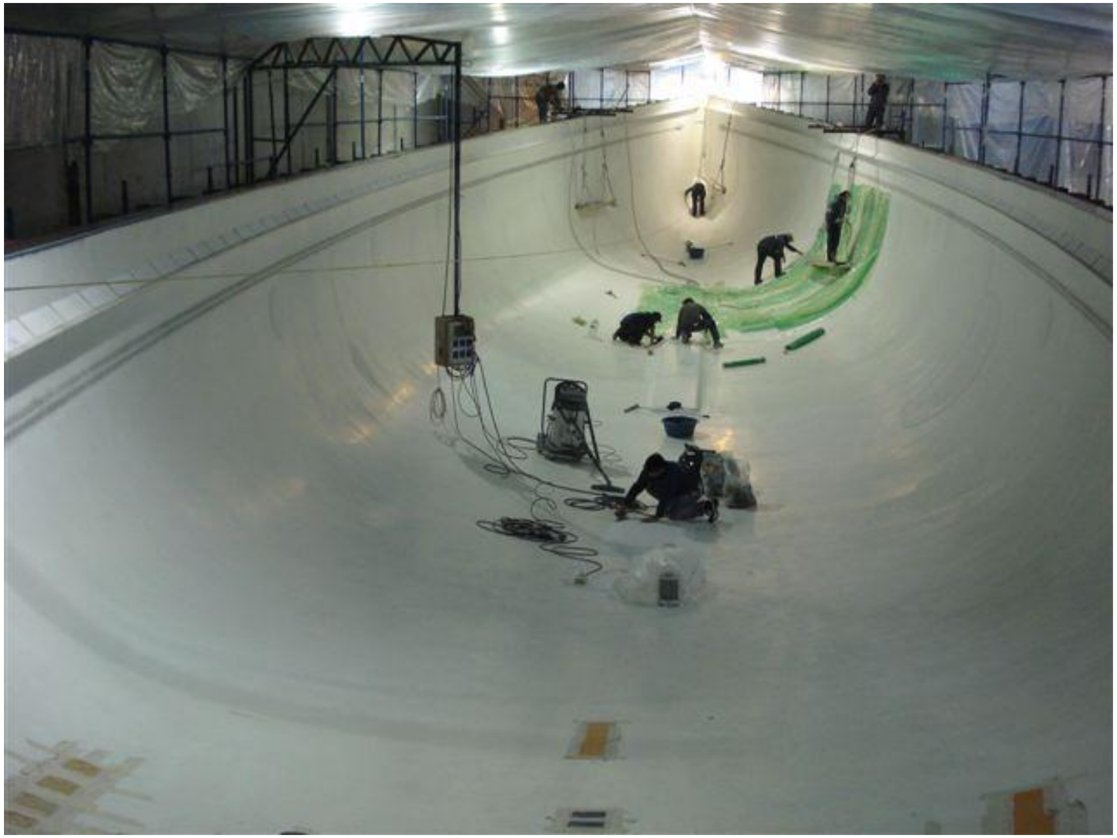


MOULD PREPARATION

3. INFUSION PROCESS

MOULD PREPARATION

3. INFUSION PROCESS



CLEANING & POROSITY TEST

3. INFUSION PROCESS

SEALING

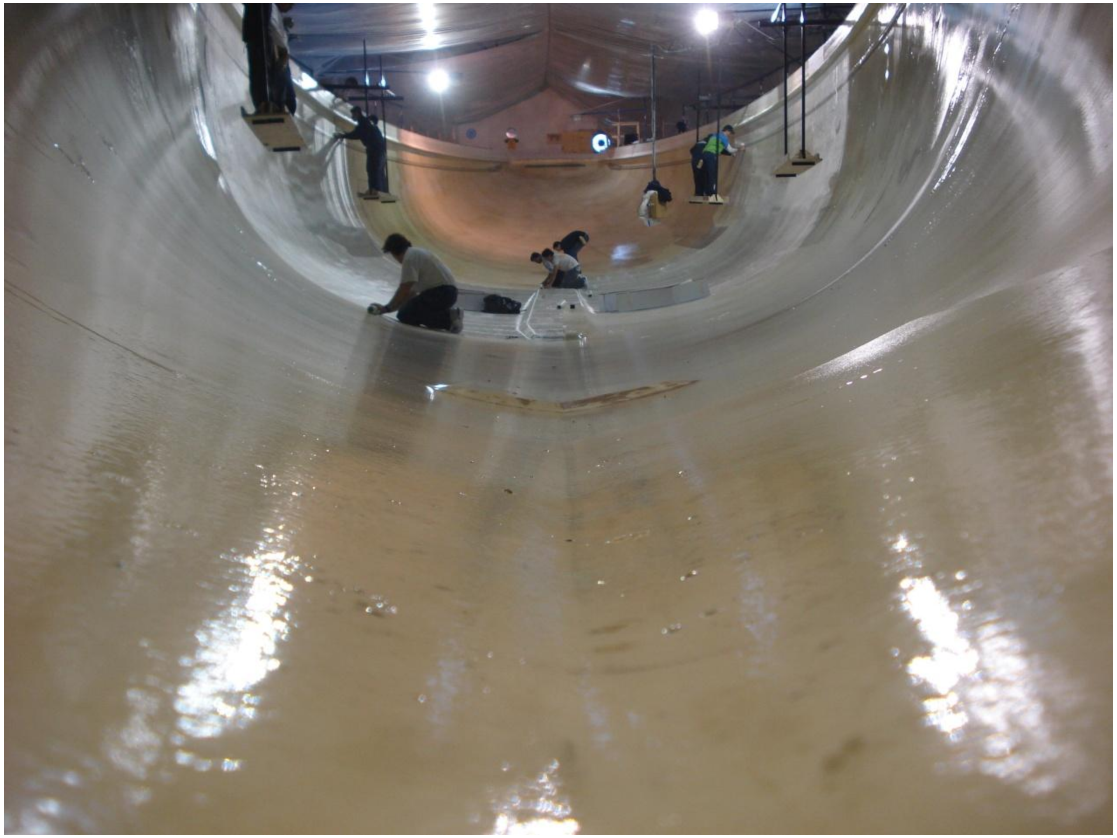
3. INFUSION PROCESS

MOULD RELEASE

3. INFUSION PROCESS

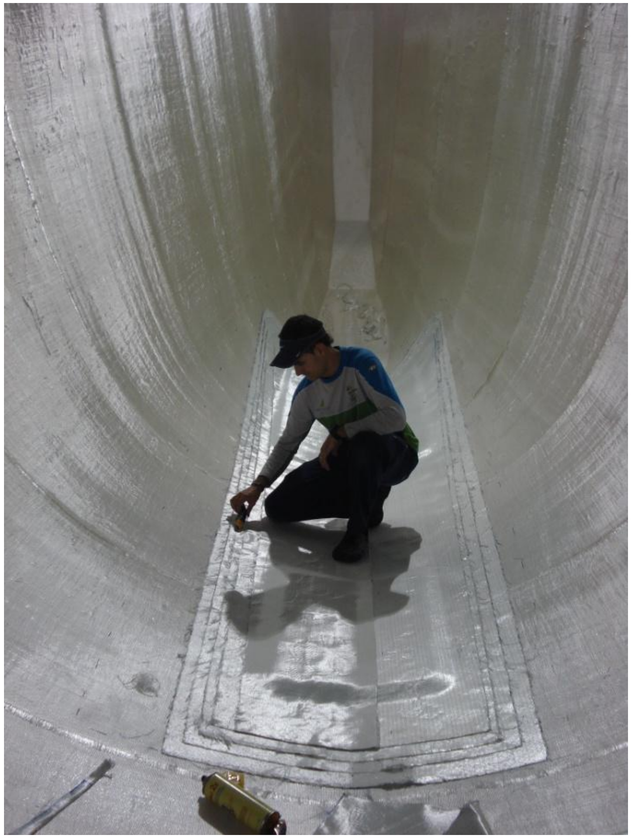
GEL COAT

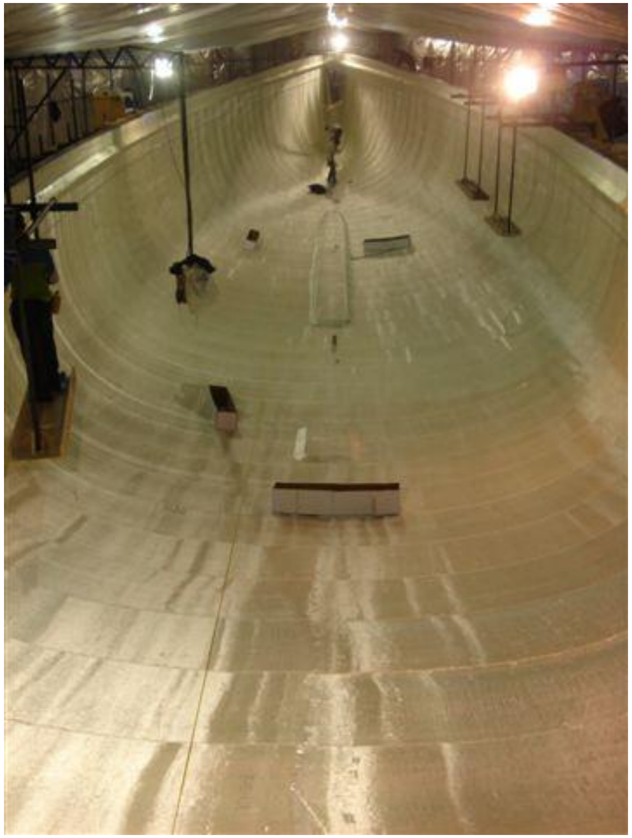
3. INFUSION PROCESS



GEL COAT AND FIRST GLASS LAY UP

3. INFUSION PROCESS





200GSM E-GLASS REINFORCEMENT

3. INFUSION PROCESS

E-GLASS MULTIAXIAL REINFORCEMENTS

3. INFUSION PROCESS

CARBON FIRST LAYER

3. INFUSION PROCESS

CARBON LAYERS

3. INFUSION PROCESS

CARBON UDs

3. INFUSION PROCESS

CARBON UDs

3. INFUSION PROCESS

PEEL-PLY

3. INFUSION PROCESS

DRAWING NETWORK

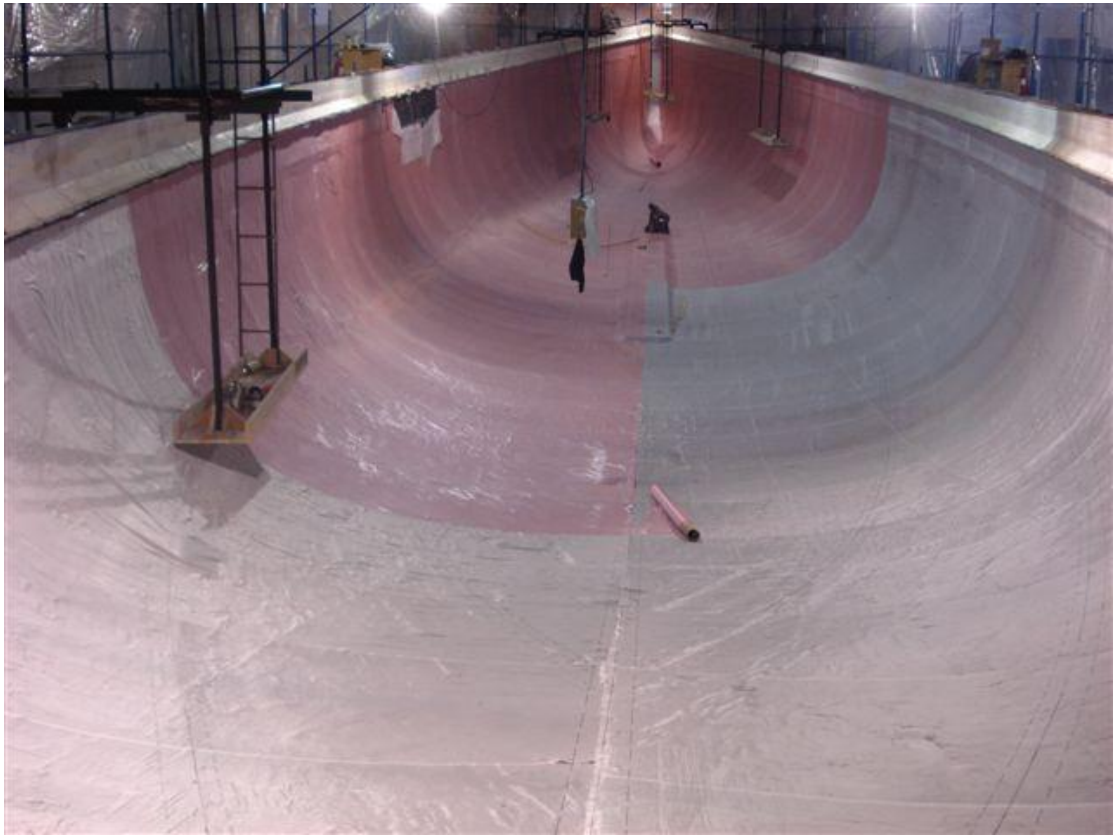
3. INFUSION PROCESS

DRAWING NETWORK

3. INFUSION PROCESS

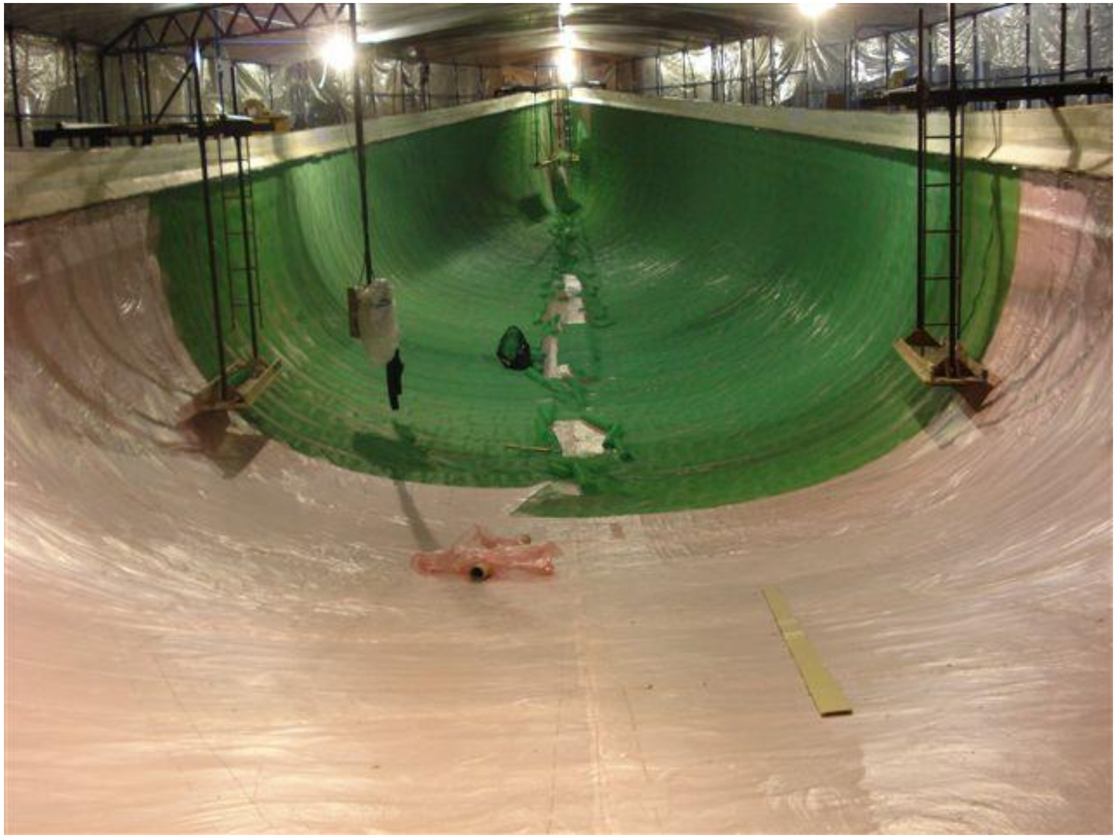
MICRO-PERFORATED

3. INFUSION PROCESS



MICRO-PERFORATED

3. INFUSION PROCESS

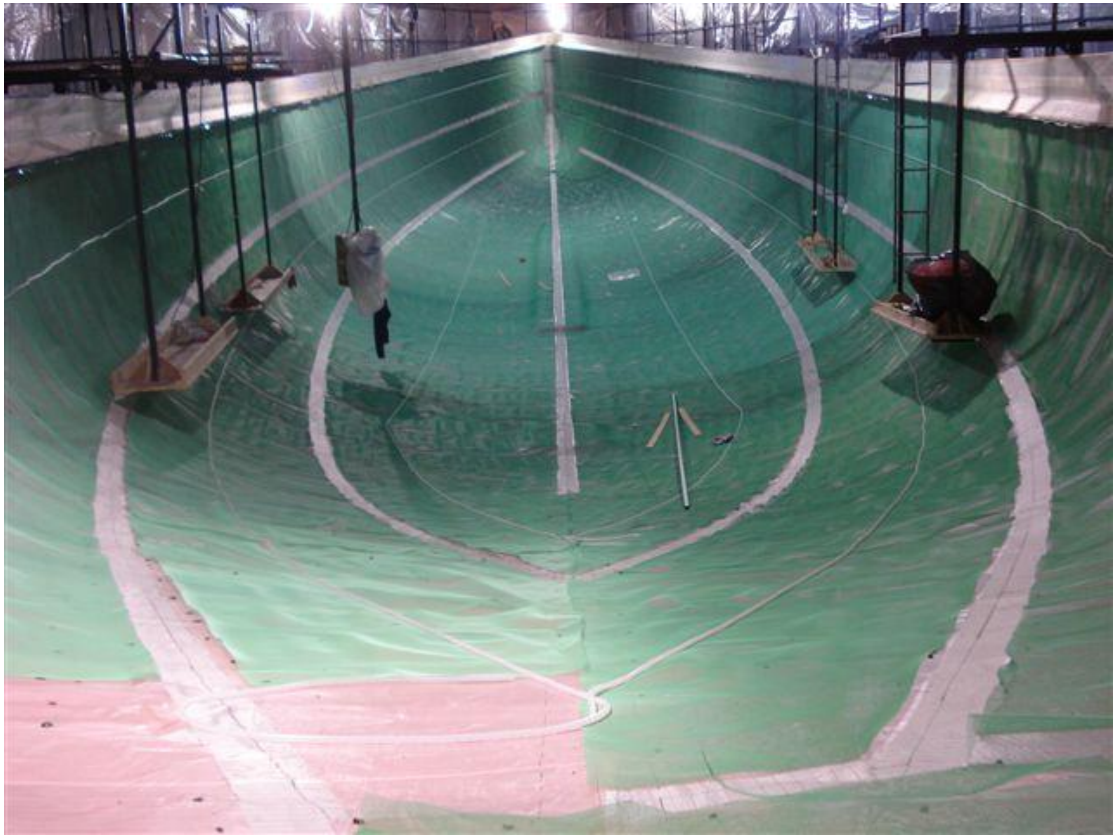


RESIN FLOW MEDIUM

3. INFUSION PROCESS

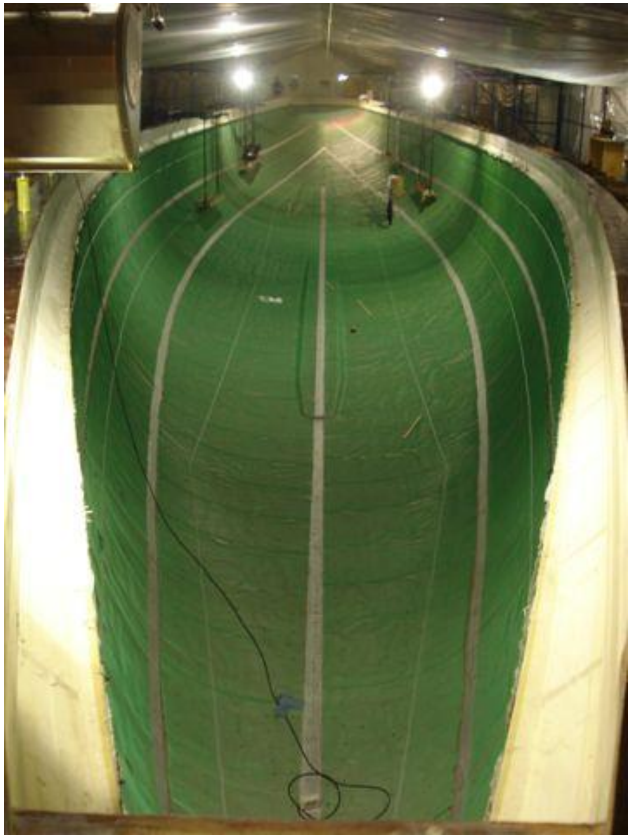
RESIN FLOW MEDIUM

3. INFUSION PROCESS



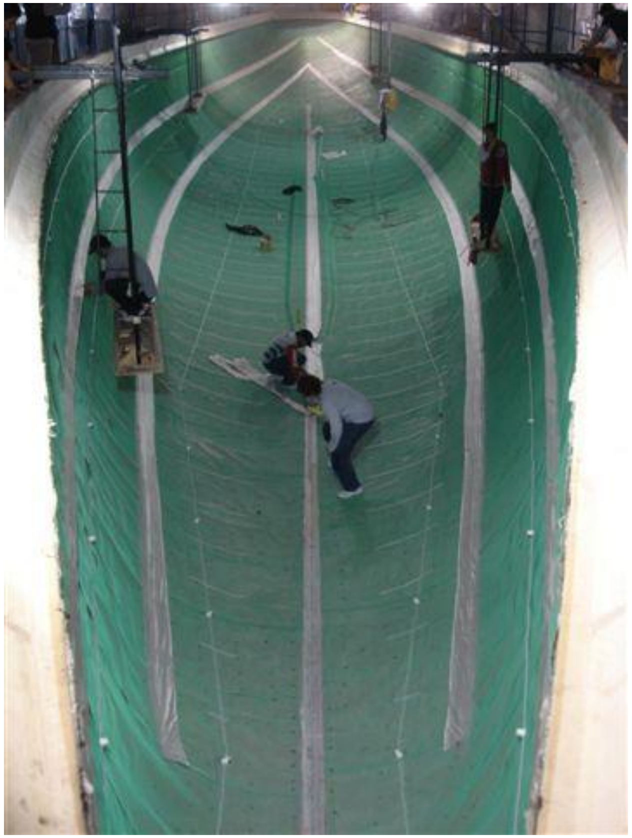
RESIN FLOW MEDIUM

3. INFUSION PROCESS



RESIN FLOW MEDIUM

3. INFUSION PROCESS



1. Process Selection
2. Material Selection and Viability Tests
3. Infusion Process
4. Conclusions

INFUSION NETWORK SETUP

3. INFUSION PROCESS

600M2 VACUUM BAG

3. INFUSION PROCESS

LOW VACUUM CONSUMIBLE POSITIONING

3. INFUSION PROCESS

LOW VACUUM CONSUMIBLE POSITIONING

3. INFUSION PROCESS

VACUUM

3. INFUSION PROCESS

LEAK SEARCH

3. INFUSION PROCESS


INFUSION START

3. INFUSION PROCESS

INFUSION START

3. INFUSION PROCESS

FIRST AREA INFUSION

3. INFUSION PROCESS

ALL AREAS INFUSION

3. INFUSION PROCESS

INFUSED

4. CONCLUSIONS

•Challenges

•Size matters! Distances to be covered, vacuum bag assembly, 80 minutes pot life needed on 90 kg of resin batches…etc…
•Selection of only 12 mm diameter resin feed hoses.
“Polar” temperatures wave to deal with in basic facilities
•No mistake allowed

•Results:

- 68% Fibre 32% Resin ratio
- 1.828 KG Resin infused in one shot
- Maximum monolitic areas infused of 36 mm thickness
- >500 m2 infused in 1hr 47min.


DOÑA FRANCISCA
HATS
ARINE
REEN


HATSI
ARINE
REEN