



*fi*RST

FILM INFUSION WITH REUSABLE SILICON TECHNOLOGY

EPSILON CLOSED MOULD SOLUTIONS

Epsilon Closed Mould Solutions, India

Technology Partner with
Alan Harper Composites, UK

ECMS





fIRST®

film infusion Reusable Silicone Technology

Improving our environment through clean,
efficient closed mould composite production.

*fi*IRST

THE ALTERNATIVE

- *ECONOMIC AND ENVIRONMENTAL FRIENDLY.*
- *PROVIDES RAPID PRODUCTION OF REUSABLE SILICON MEMBRANE TOOL FACES.*
- *ALLOW EASE OF MANUFACTURE FOR UNDERCUT DESIGNS (NEGATIVE DRAFT) &*
- *COST EFFECTIVE ALTERNATIVE TO COSTLY CONSUMABLE VACUUM BAGS*

*fi*RST - How it works!

- SILICON BAG HOLDS TO THE MOLD THROUGH VACUUM CLAMPING ALL ALONG THE EDGE OF THE MOLD.
- VACUUM REQUIRED IS AT LEAST 90 % OR BETTER FOR EFFICIENT USE OF PROCESS
- RESIN IS ALLOWED TO ENTER THROUGH STRATEGICALLY PLACED INSERTS & / OR RESIN RUNNERS
- MOLDING COMPACTION TAKES PLACE UNDER APPLIED VACUUM
- -VE ANGLES OR UNDERCUT MOLDING IS FEASIBLE AS SILICON MEMBRANE IS FLEXIBLE
- SILICON MEMBRANE CAN BE REMOVED QUICKLY ONCE INITIAL CURE TAKES PLACE
- SILICON BEING SELF RELEASING NO NEED OF RELEASE COAT.
- RESIN TO GLASS RATIO ACHIEVED 1:1 OR BETTER DEPENDING ON GLASS DENSITY AND PERMEABILITY

The advantages

- ▶ Speed - faster than LRTM or Traditional Infusion
- ▶ Works well GP hand lay resin. No special resin
- ▶ Almost net size – fast post finishing
- ▶ Very Low resin waste
- ▶ No need for Catchpots
- ▶ No need for 2 vacuum levels
- ▶ No pipes to set up, seal and then waste
- ▶ No need of mixing machine and hi tech control

Advantages continued

- ▶ No need for thru bag fittings and resin feed channels *
- ▶ Bag set up time ready to mold – seconds !
- ▶ Self cleaning – no release agent required
- ▶ Lowest investment route to closed mold production
- ▶ Can mold different core thicknesses and lay up schedules with same bag
- ▶ Can mold negative draft designs without problem

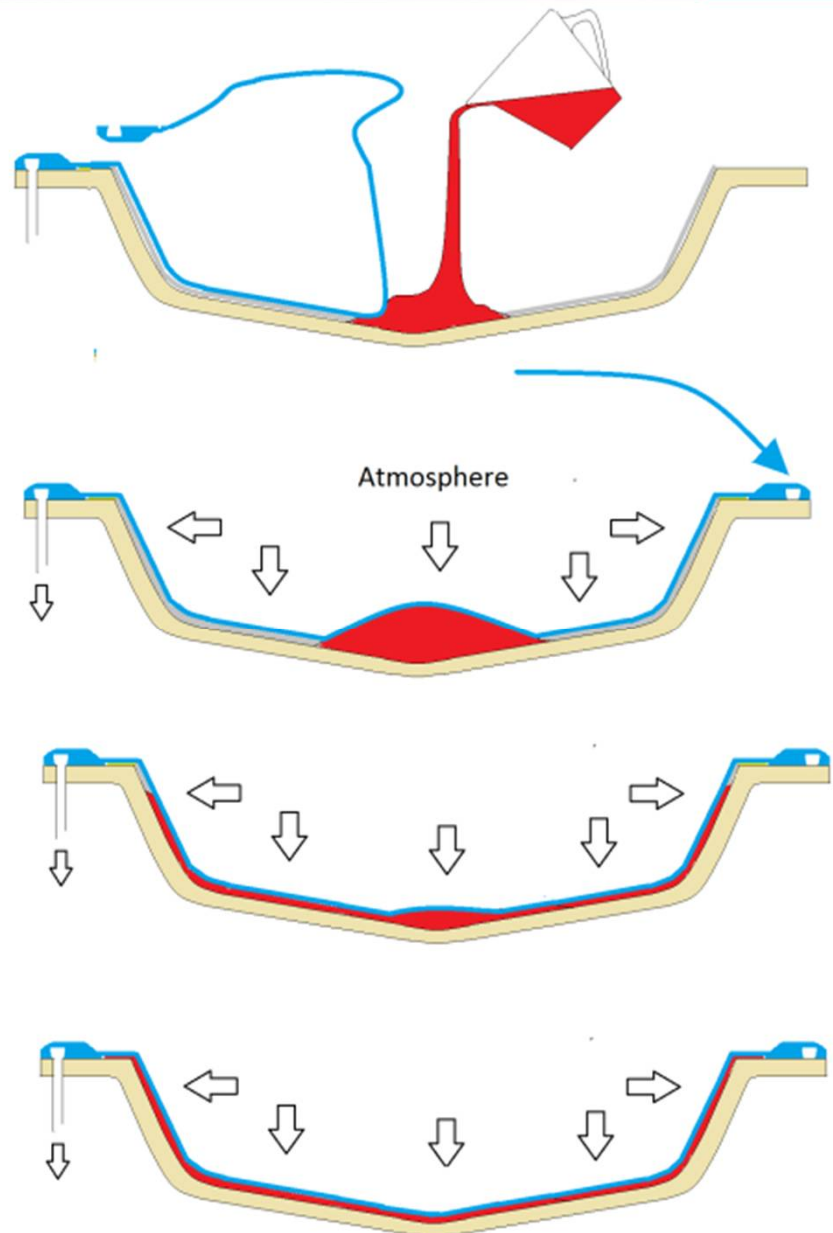
What is VPI?

- ▶ **V**acuum . To remove air
- ▶ **P**ress . To press down on resin
- ▶ **I**nfusion. To flow resin throughout mould

VPI™ - the Process

- ▶ Use normal open mould to place glass mat
- ▶ Cover with Reusable Vacuum bag
- ▶ Pour measured resin shot on fibre under bag
- ▶ Close bag and apply vacuum
- ▶ Infuse rapidly

Process steps



PROCESS COMPARISON

VACUUM INFUSION WITH RVB - <i>fiRST</i>	HAND LAY-UP
Closed Moulding Process - Precise and cleaner.	Open Mould process
Resin infusion under Vacuum.	Resin application by hand using brush, Rollers.
Reduced styrene emission provides superior working environment and environmental Policy Compliance.	Because of open mould, styrene emission is a major environmental concern, hence process is rejected by several environment conscious OEM buyers.

PROCESS COMPARISON

VACUUM INFUSION WITH RVB - <i>fiRST</i>	HAND LAY-UP
Equipment Controlled process with Vacuum pump, ancillaries and Special reinforcement with flow medium	Simple, Labour Intensive, error prone process
More control on material placement, Uniform resin catalization and resin distribution thereby producing parts with consistent quality.	Quality of the components depend heavily on the operator's skills and experience. Uneven resin distribution & curing leads to uneven shrinkage & warpage.
Glass to resin ratio, $G : R = 1 : 1$ or $1 : 1.5$, Process helps achieve higher glass loading resulting in higher mechanical properties.	Glass to resin ratio, $G : R = 1 : 2$, Lower mechanical properties due to lower fibre content.

PROCESS COMPARISON

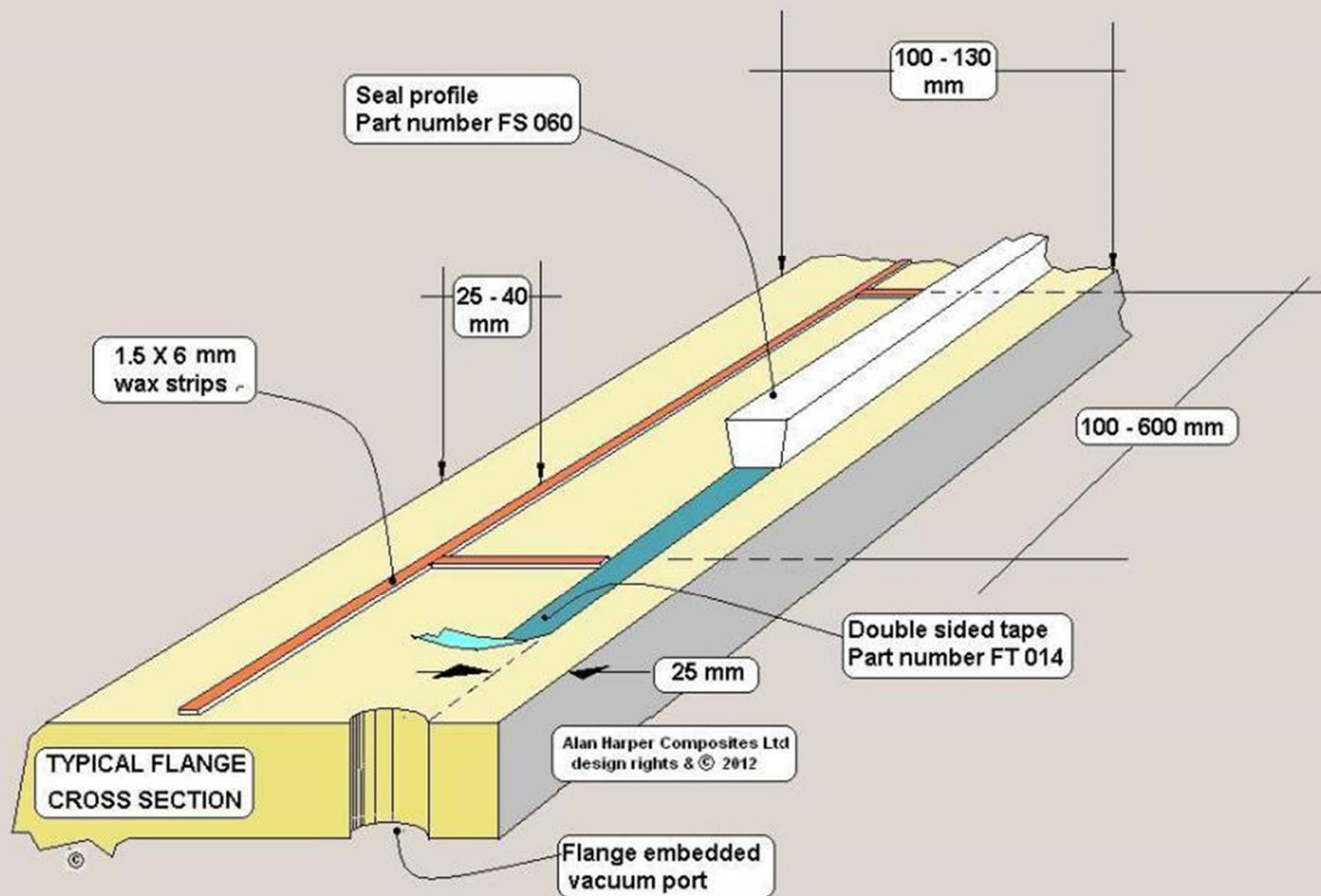
VACUUM INFUSION WITH RVB - <i>fi</i> RST	HAND LAY-UP
3 to 4 moulding cycles per mould per shift with use of closed mould fast cure AAP catalyst.	Maximum only 1 moulding cycle per mould per shift as fast cure catalyst use is not feasible.
Control of temperature during cure can be used to reduce the production time.	Temperature control not possible.
Process doesn't permit filler addition in the resin. Hence quality of part is assured for part buyer.	Cutting corners like Filled resins can be used by vendor to reduce the costs, it increases the weight and decreases the mechanical properties of FRP parts.

PROCESS COMPARISON

VACUUM INFUSION WITH RVB - <i>fi</i> IRST	HAND LAY-UP
Produce parts with minimal or no void content in the laminate.	Parts contain lots of voids in the laminate which affects the laminate mechanical properties, pop ups can show after the part is in services and undergoes thermal cycles.

How do I adapt this process

- ▶ Face mold with 130mm wide flange all along edge is pre-requisite
- ▶ Flange surface to be smooth to ensure quick edge vacuum hold
- ▶ Orientation change in X,Y or Z direction of flange path to have at least 50mm radii
- ▶ Cavity calibration- either molded part with back side surface finished smooth to 400grit size or better.
- ▶ Calibration part to be uniform in thickness
- ▶ Alternatively use Cork or wax sheet calibration method



Spray machine



SilCon

Silicone spray
machine

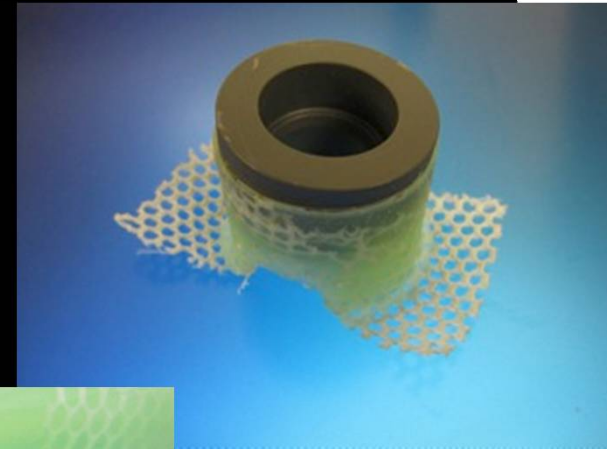
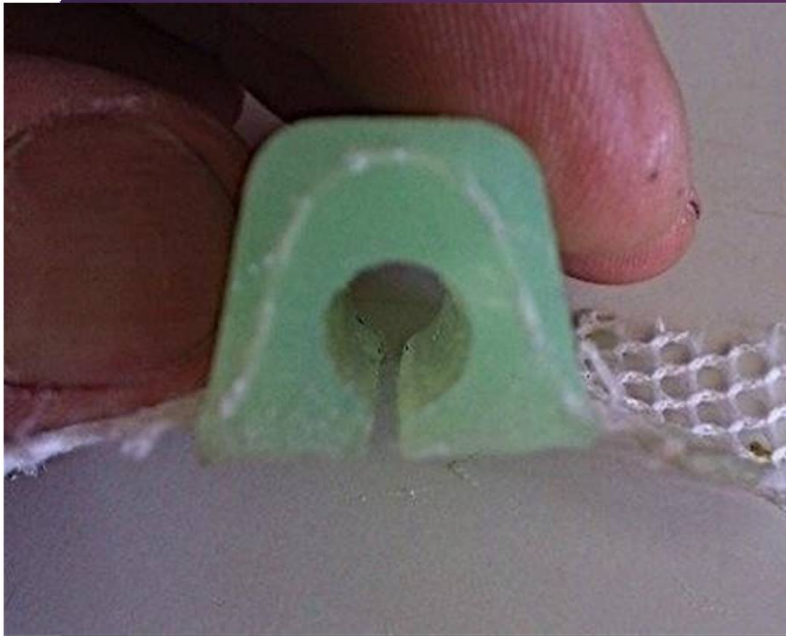


SilCon V

Thixotropic on
demand

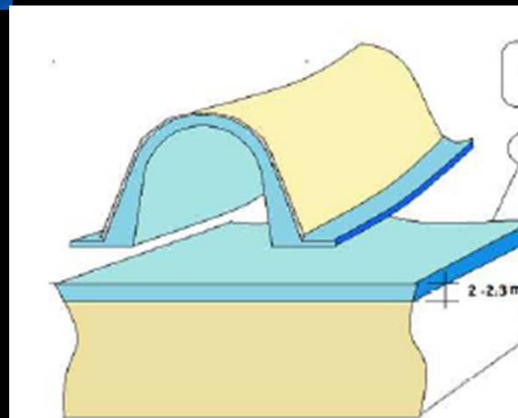
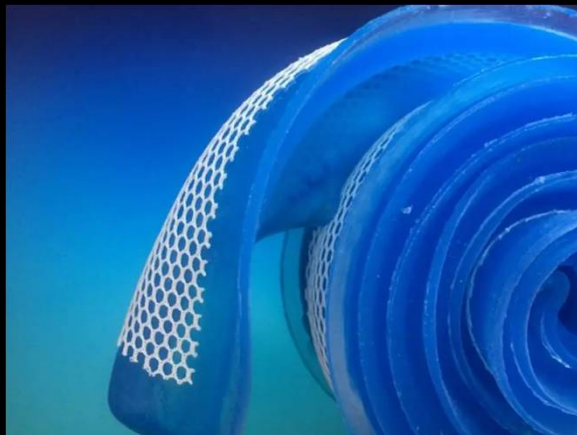
Resin Runner and saddle insert

All have “feathers” to
securely bond for life
in to silicone
membrane



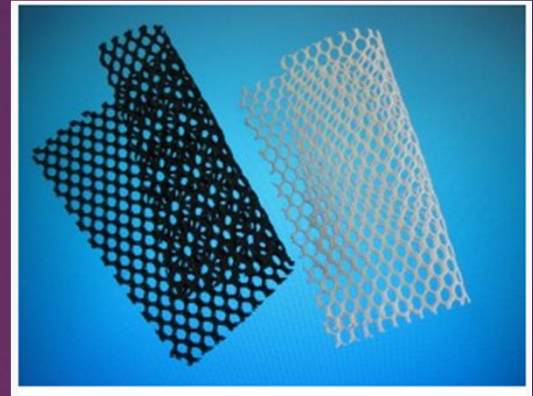
Morph Runner and insert

All have “feathers” to
securely bond for life
in to silicone
membrane



Ancillaries

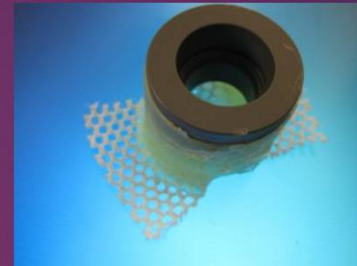
- **REINFORCEMENT CLOTH** - STANDARD WHITE AND HIGH STRENGTH BLACK. HIGHLY COMPLIANT WITH EXCELLENT SILICONE ABSORPTION CHARACTERISTICS



- **INJECTION FITTING** – 10 MM PLUG IN SEALED PIPE



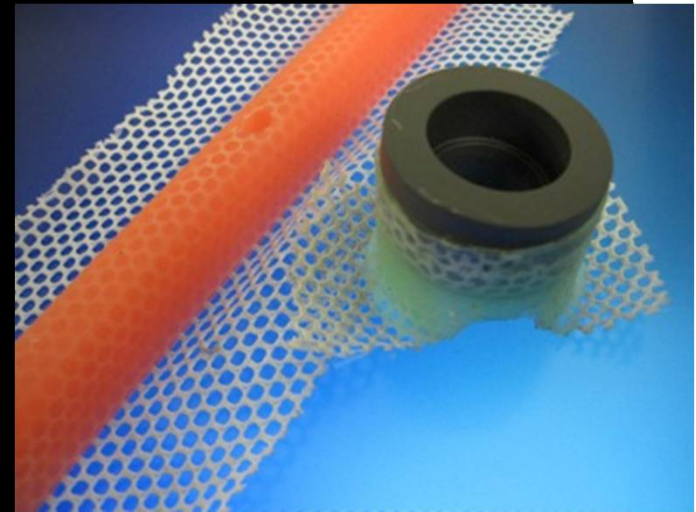
- **SADDLE INSERT** - RESIN INFUSION/ VACUUM CONNECTOR TO RESIN RUNNER SECTION. PERFECT FIT ON TOP OF RUNNER SECTION INCORPORATING BONDED REINFORCEMENT



- **RESIN RUNNER** - PROVIDES FLOW JUNCTIONS FOR MORE COMPLEX RESIN RUNNER LAYOUTS



Calibration of Face mould



Seal profile runner and inserts and calibration wax

Making a reusable silicone bag

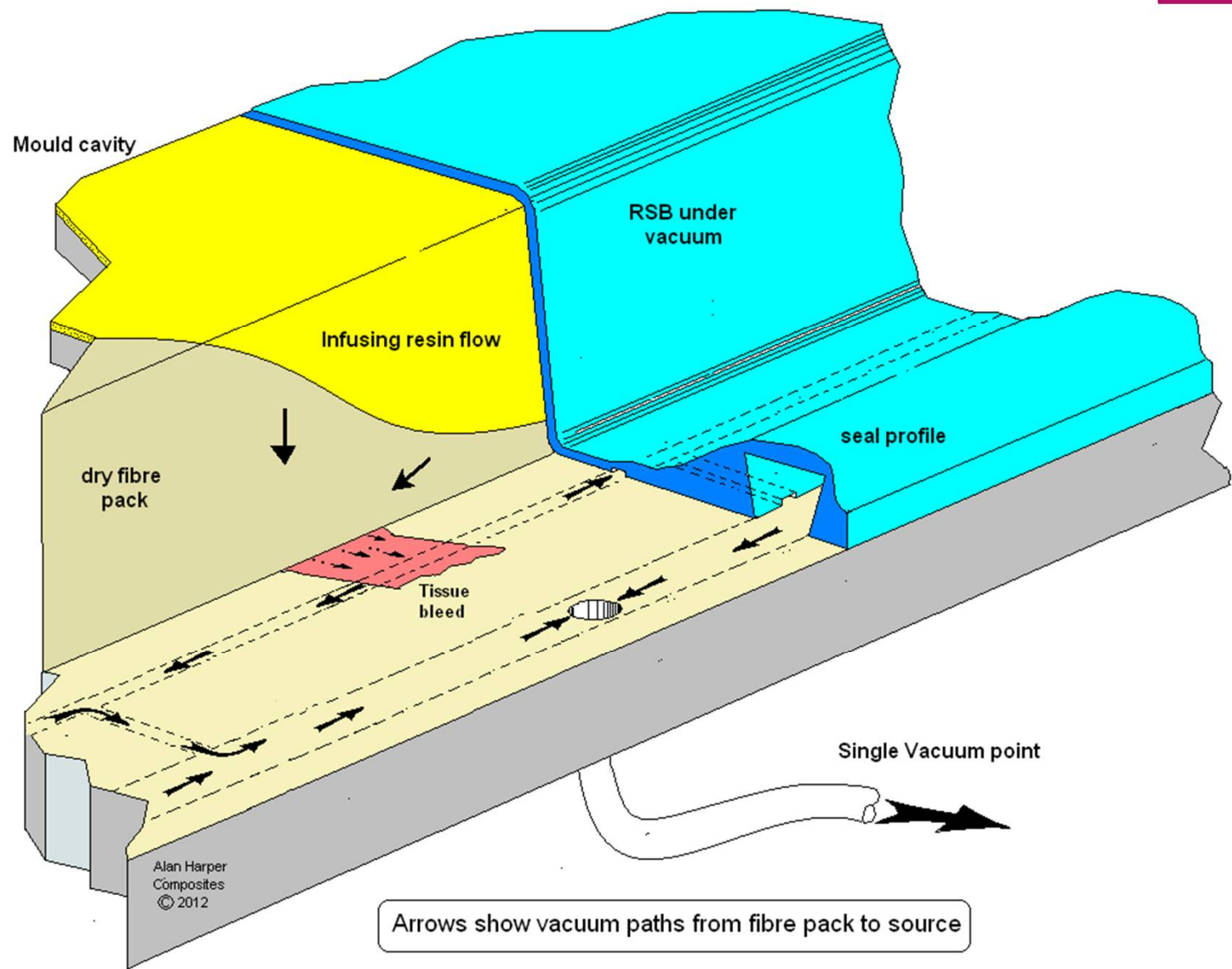
- ▶ Silicone easy 1:1 ratio to machine
- ▶ Rate up to 2.3 Kg/min *
- ▶ 1m² within 2 mins. max.
- ▶ Completely air bubble free
- ▶ Cure times 0.1 – 5.0 hours
- ▶ Skill achieved in 2-3 hours

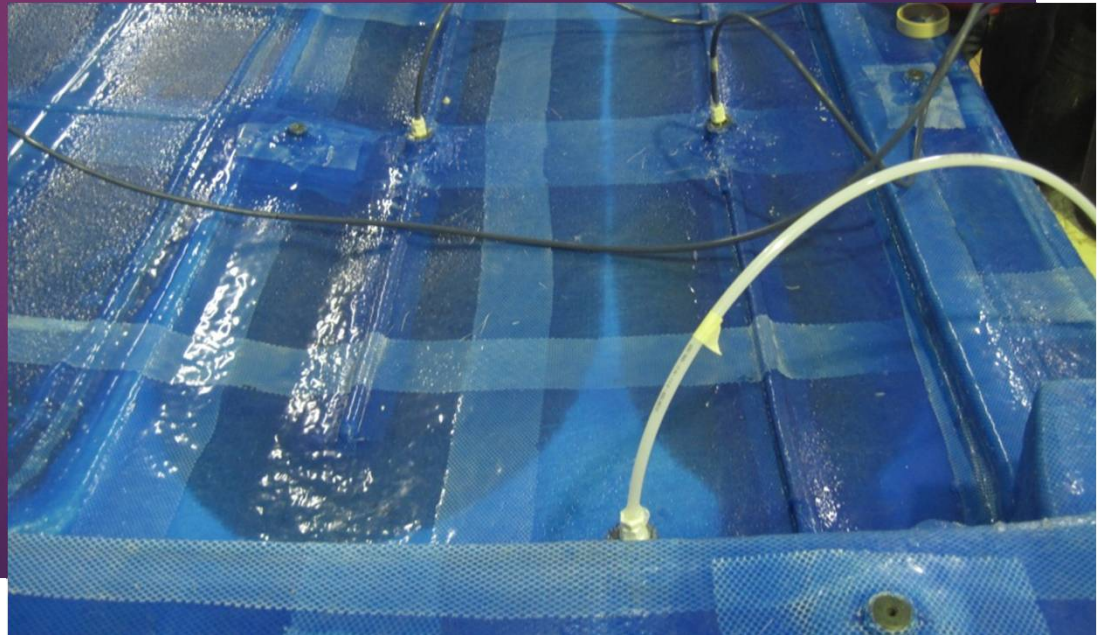
(* Temperature and manufacturer dependent)





SILICON SPRAYING STAGE ON THE CALIBRATED FACE TOOL



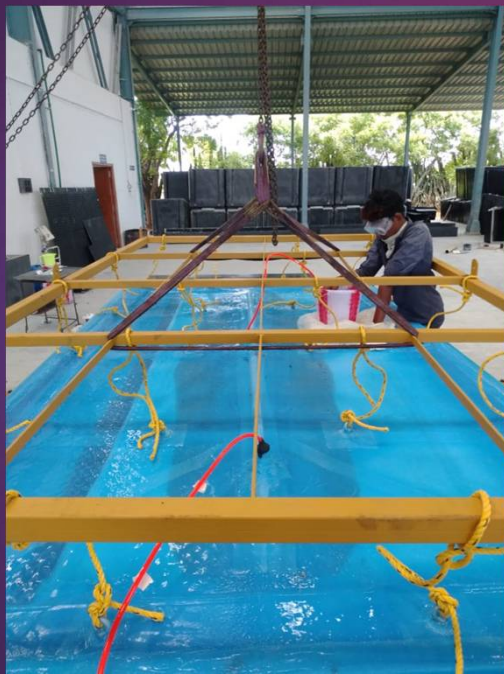




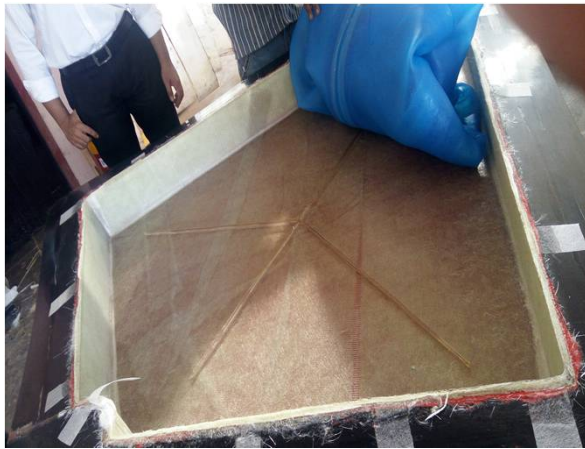
- **7.5 M² BAG DEVELOPED IN 4 HRS**
- **CURED TRIMMED & READY FOR LOADING IN 2HRS**



BUS – FRONT FACE, FLAP, FRONT BUMPER



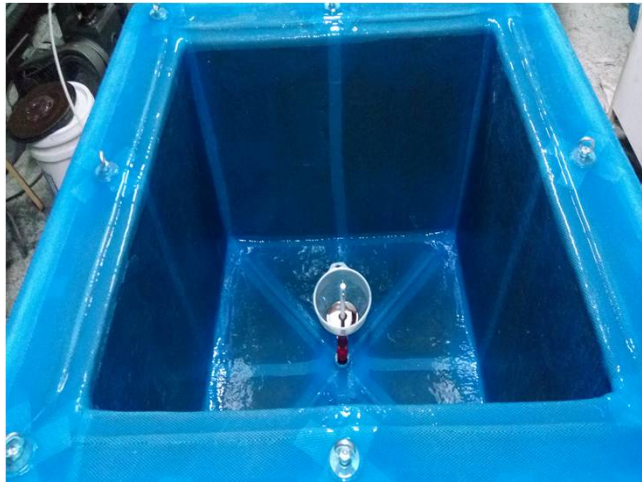
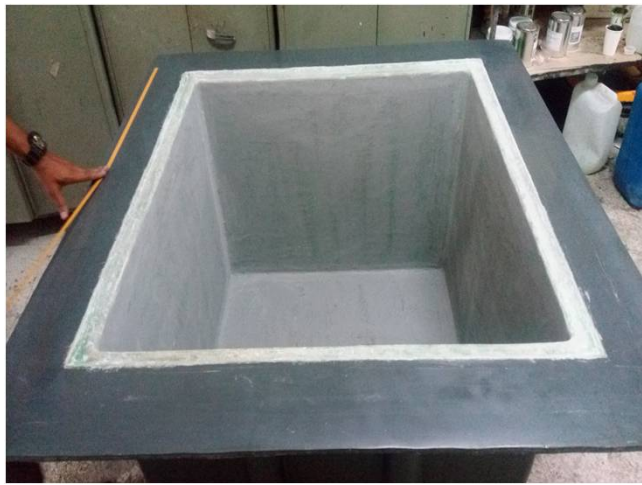
FLAT CHEQUERED PLATE



Client: Arihant industries, Vasai
Part Name: Platform roof



Client: Arihant industries, vasai
part: wave slide large



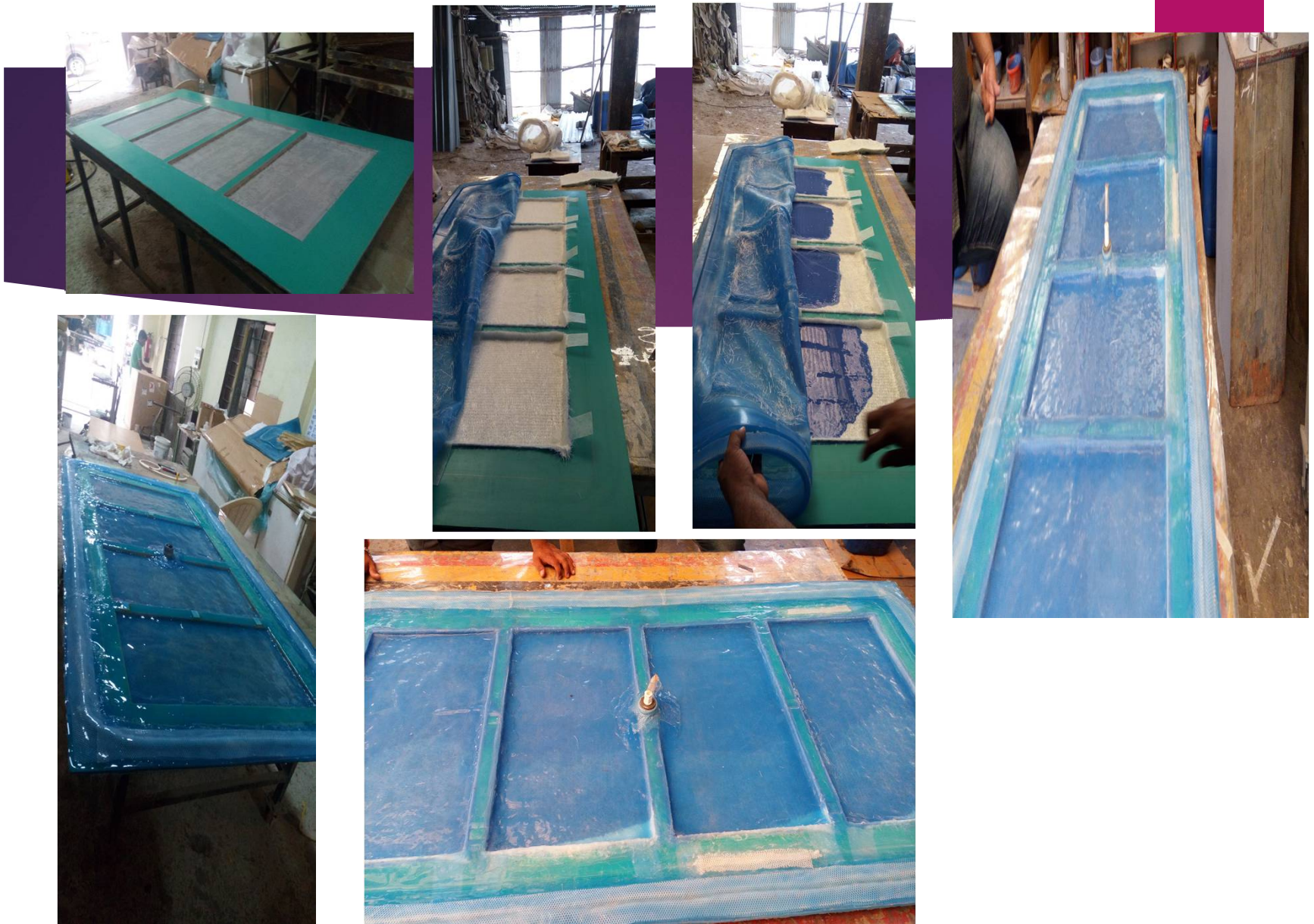
Client: banka bioloo limited

part: biotank 700 lits



Client: dc design, pune

part: fender (Carbon – vinyl)



Client: fibropolymer, Kolhapur

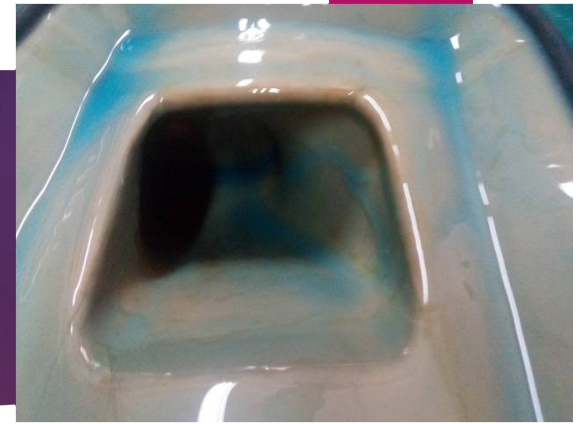
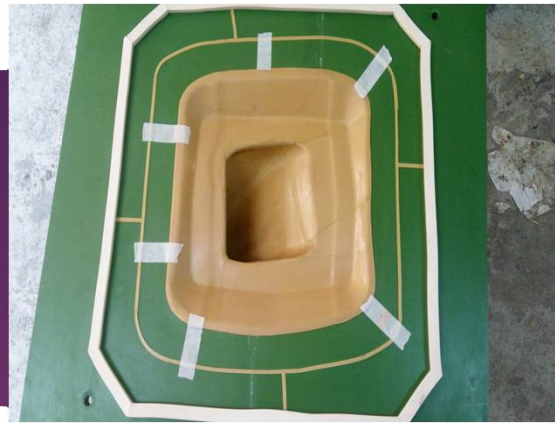
Part: bench top – multicavity mould



Client: Jayem automotive, Coimbatore

part: bumper







Client: Suvarna Fibrotech, Pune

Part: Ashok Leyland Bus rear fascia







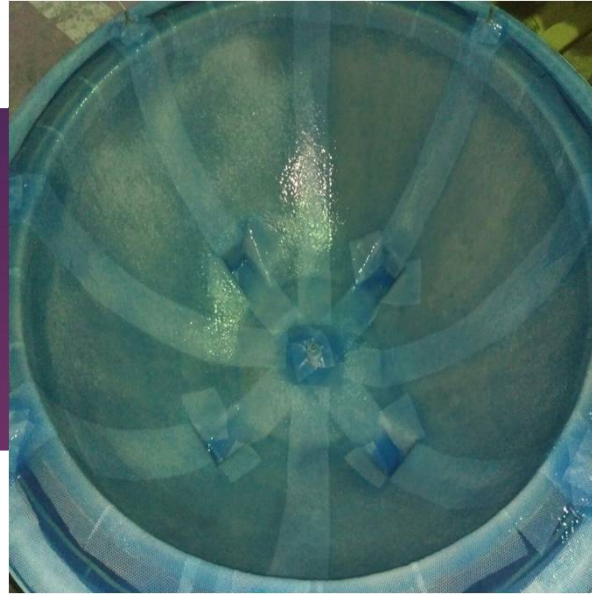
Client: Suvarna fibrotech, Pune

Part: ACGH HAWK bus rear

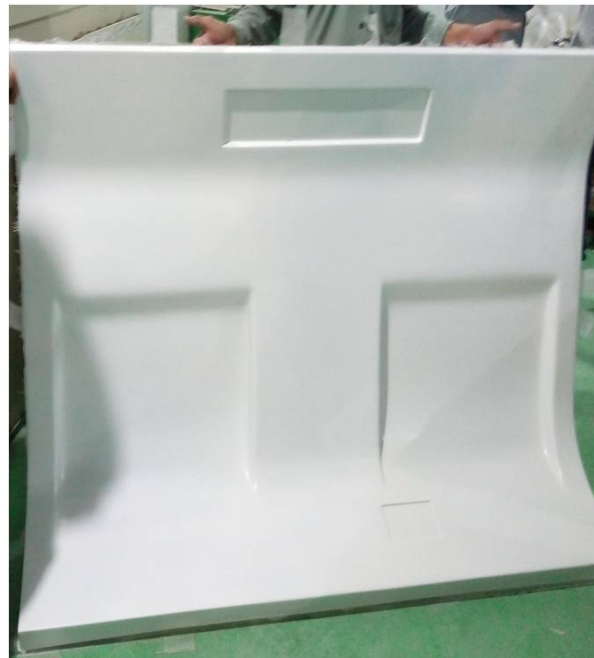
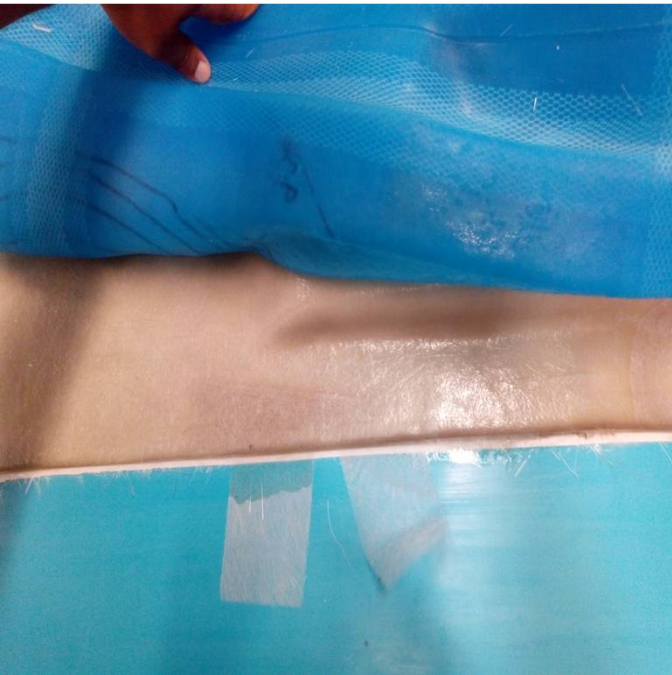
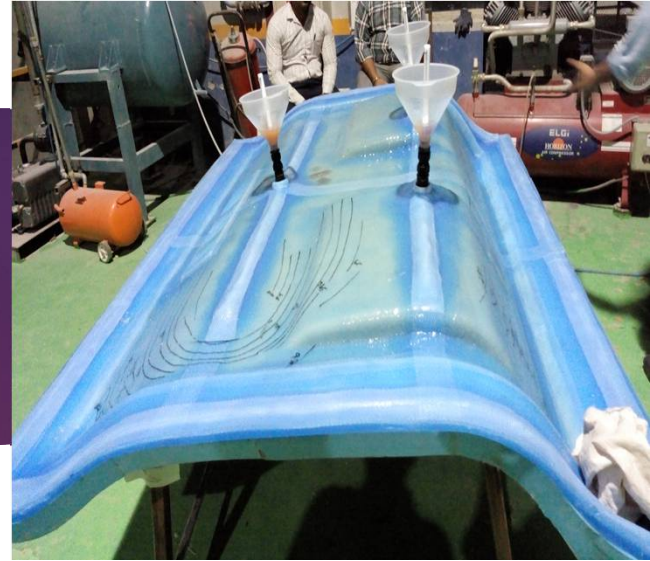


Client: Suvarna, Pune

Part: ACGL bus Front

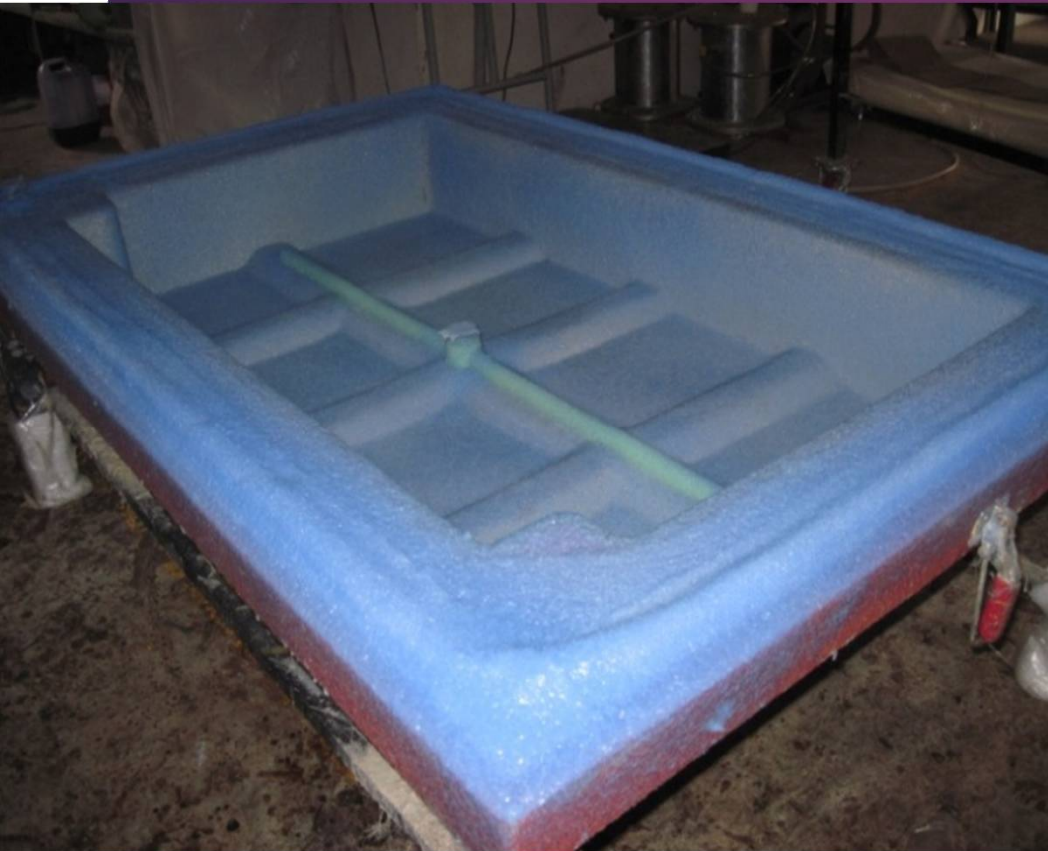


Client: icp india pvt ltd
part: 2000 L water tank





"Net Shape" Full perfect fit -
even for complex shapes and
undercuts





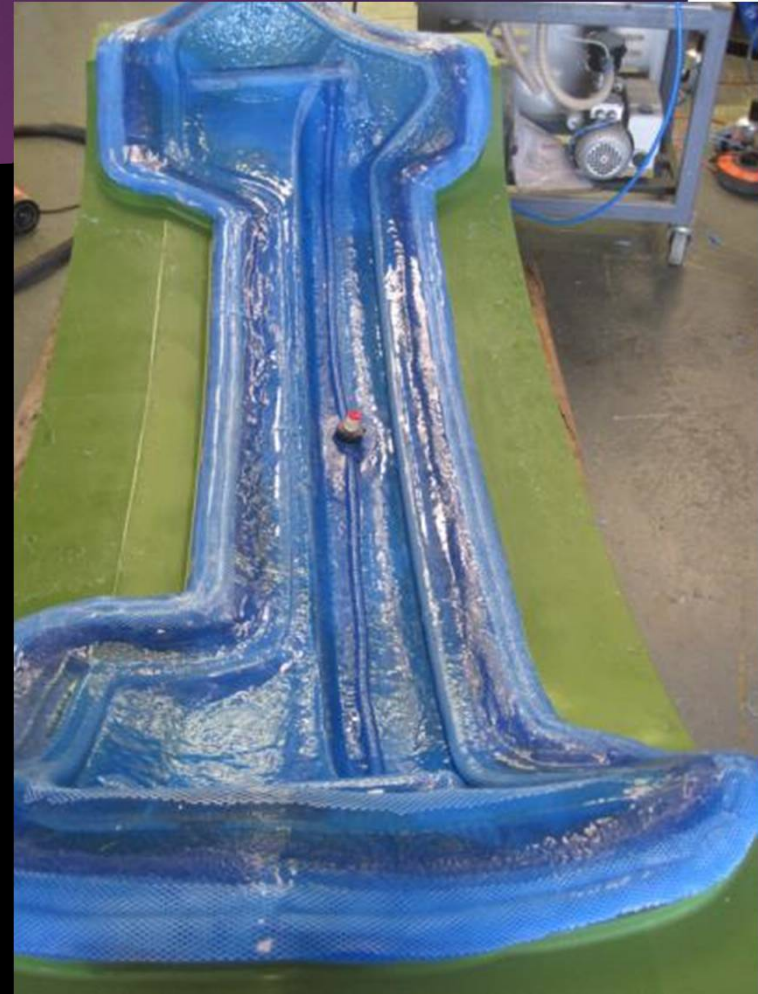
Demonstration of part molding

Examples

- ▶ Automotive
- ▶ High end carbon epoxy.
- ▶ Ferrari by Gurit, UK
- ▶ X 340



Automotive



\ Pre preg Carbon epoxy above.x 400
230 x Front bumper part by Polyester
VPI >

Cobham racing

► Air Box.



Brazil Now uses this technology

Marco
Polo
Brazil by
MVC




RS Sailing model 2000



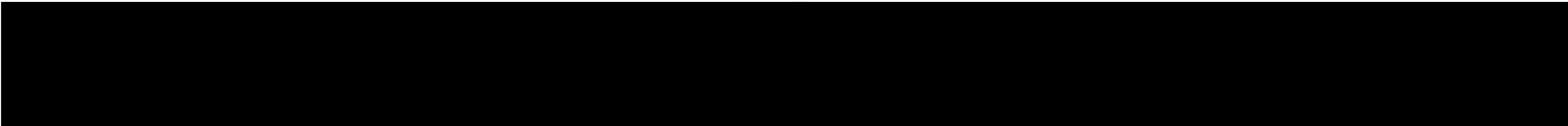
Self sealing Reusable vacuum bag can be loaded and vacuumed down within 4 minutes by one operator





July 2014 , Marco Polo
say.....

Launched recently, the RTM Skin process is already used in the manufacture of complex parts for the wind energy market, tractors fairings or bus rear and front bumpers, generating several benefits (Fig. 2 & 3).



Wrightbus UK

- ▶ Now using RVB for last 2 years.



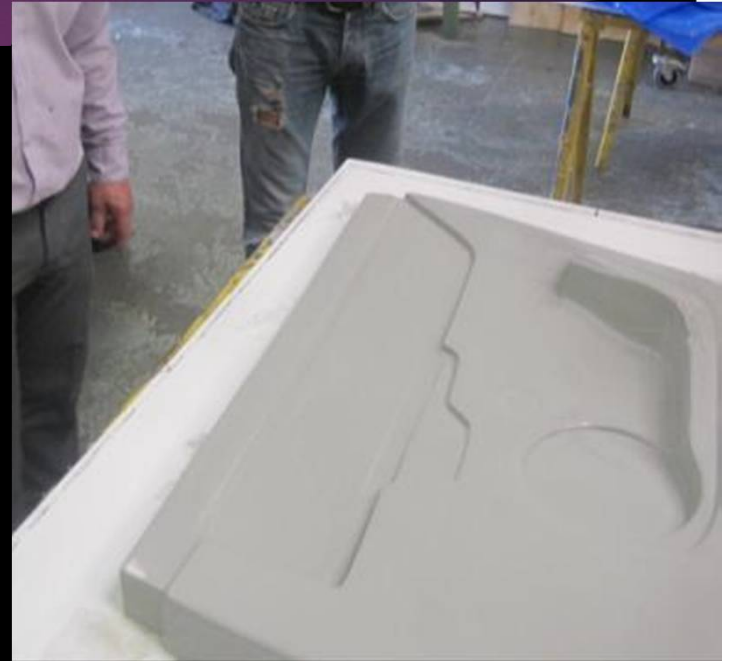
Wrightbus again

► Rear destination box



Eagle Specialist Vehicles, UK

- ▶ Car door inner.
- ▶ Note net size from mould



Malaysia Aug 2014



Fibrovent - Chile

12m² tank cover VPI
bag mould.
30 kg resin pour .
Only 5 minute to
infuse < 2 % waste



Heated reusable vacuum membranes



Unique embedded stretchable
heater cloth

Limitations of fIRST

- ONLY SINGLE GEL COATED FINISH IS FEASIBLE
- USE OF FILLED RESIN IS FEASIBLE WITH PARTICLE SIZE 5 MICRON
- MINIMUM VOLUME / QUANTITY

Cost Analysis for Rear Face

- MATERIAL COST FOR MAKING 230 PARTS OF REAR FACE THROUGH HLU WILL BE RS. 9,47,830/-
- MATERIAL COST OF MAKING 230 PARTS OF REAR FACE THROUGH FIRST WILL BE RS. 7,01,730
- THE SILICON BAG WILL COST RS. 2,40,000/-
- THE BAG COST WILL BE RECOVERED AFTER 230TH DE-MOULDING

CONCLUSION: IF YOU WISH TO MOULD MORE THAN 250 PARTS FROM A SINGLE MOULD, REUSABLE SILICON BAG IS THE BEST AVAILABLE OPTION FOR YOU TO IMPROVE THE PART QUALITY, REDUCING CYCLE TIME & CONSIDERABLE COST SAVING, GIVING YOU AN SUPERIOR EDGE TO THE OTHER PART MANUFACTURERS.

Labour Cost Analysis

- TOTAL TIME TO MANUFACTURE THE REAR FACE IN HLU IS APPROXIMATELY 6 HRS
- TIME TO MANUFACTURE THE REAR FACE IN FIRST WILL BE APPROXIMATELY 2.5 HRS
- ECONOMICAL SINCE TAKES ONLY HALF TIME TO COMPLETE THE PRODUCTION CYCLE.

CONCLUSION: REDUCTION IN CYCLE TIME IMPLIES TO INCREASED IN PRODUCTIVITY RESULTING IN SAVING THE LABOUR COST.

Conclusion

- ❖ REUSABLE SILICON TECHNOLOGY MOST ADVANCED & ECONOMICALLY VIABLE OVER ALL THE CLOSED MOULD TECHNOLOGIES AVAILABLE TODAY.
- ❖ ONE CAN ACHIEVE MORE GLASS PERCENTAGE.
- ❖ PROVIDES LABOUR SAVING
- ❖ ELIMINATE LABOUR DEPENDENCY
- ❖ ENVIRONMENTAL WASTE IMPACT CONSIDERABLY LESS



Thank You...

QUESTIONS ??????



Thank You...

EPSILON CLOSED MOULD SOLUTIONS

MUKUND@CDTECS.COM

VIJAY@CDTECS.COM

WWW.CDTECS.COM