

# NEW TOOL FOR PROCESS DEFINITION

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- Who is PPE?
- **RTM PROCESS 2**, the software for process selection
  - Presentation
  - Study of an application case

# WHO IS PPE ?



PPE in few words:

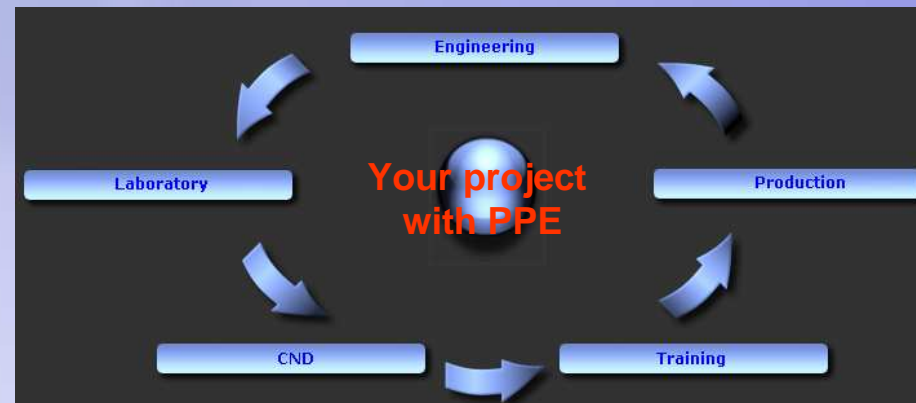
- creation 1989
- **International technology transfer center specialized in long fibers reinforced composites with thermosetting and thermoplastic resin.**

Processes specialization:

*RTM, infusion and compression*

- ISO 9001 certified since 1997

PPE can assist you in all your composite projects



- Design
- Process selection and injection simulation
- Material definition & characterization
- Tool design
- Prototype manufacturing & small productions
- Technology transfer & implementation on site
- Non Destructive Testings

**The PPE has performed around 500 technological transfers all around the world in the past 15 years in aeronautics, transportation, yacht building, construction,...**

**So, using this experience at the service of composites end users, PPE has developed RTM Process 2.**

**RTM Process 2, the ultimate tool to assist you in the process selection, ... and more.**

# RTM PROCESS 2, the software for process selection



# Presentation of RTM Process 2

## Functions:

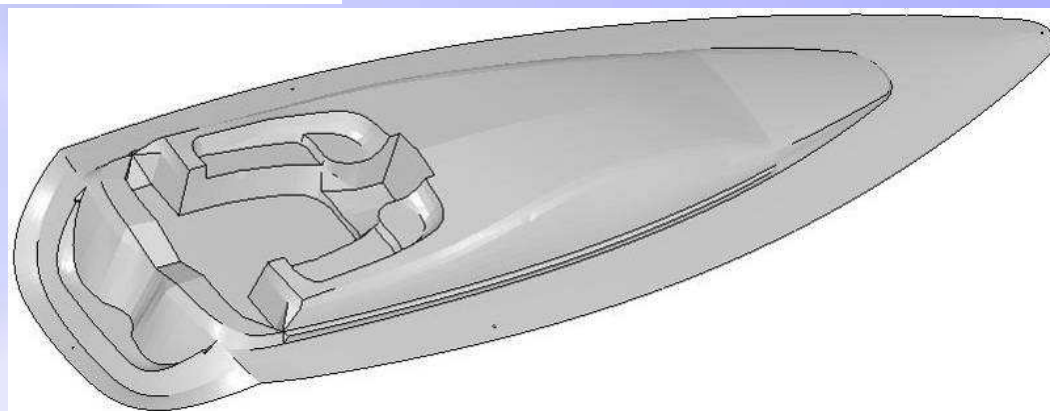
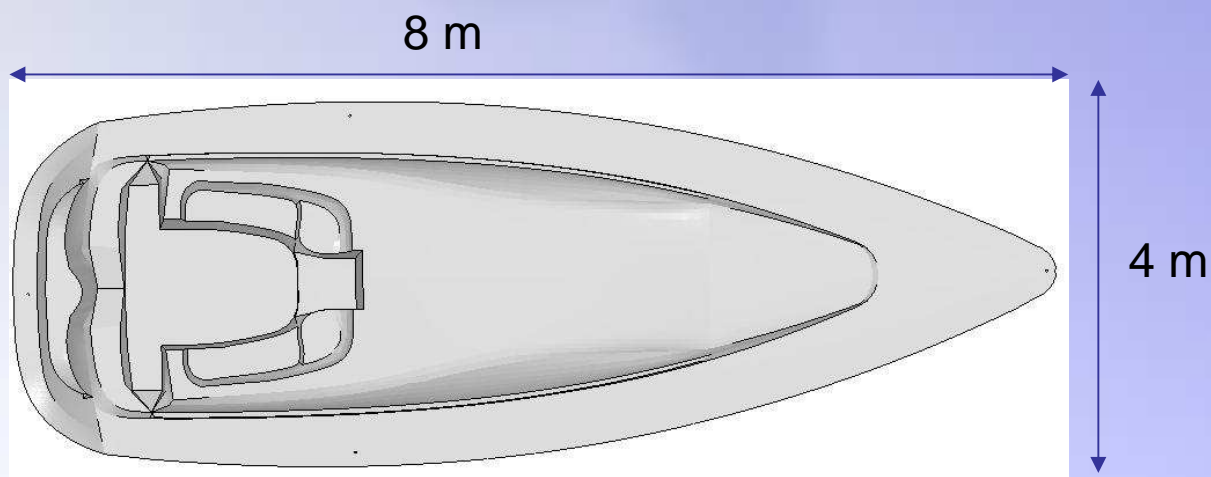
- Mechanical properties
  - Sandwich
  - monolithic
- Permeability / Simulation
- Process selection
- Mould structure
- Cost of a part
- Material data base

Complete  
assistance for  
project definition

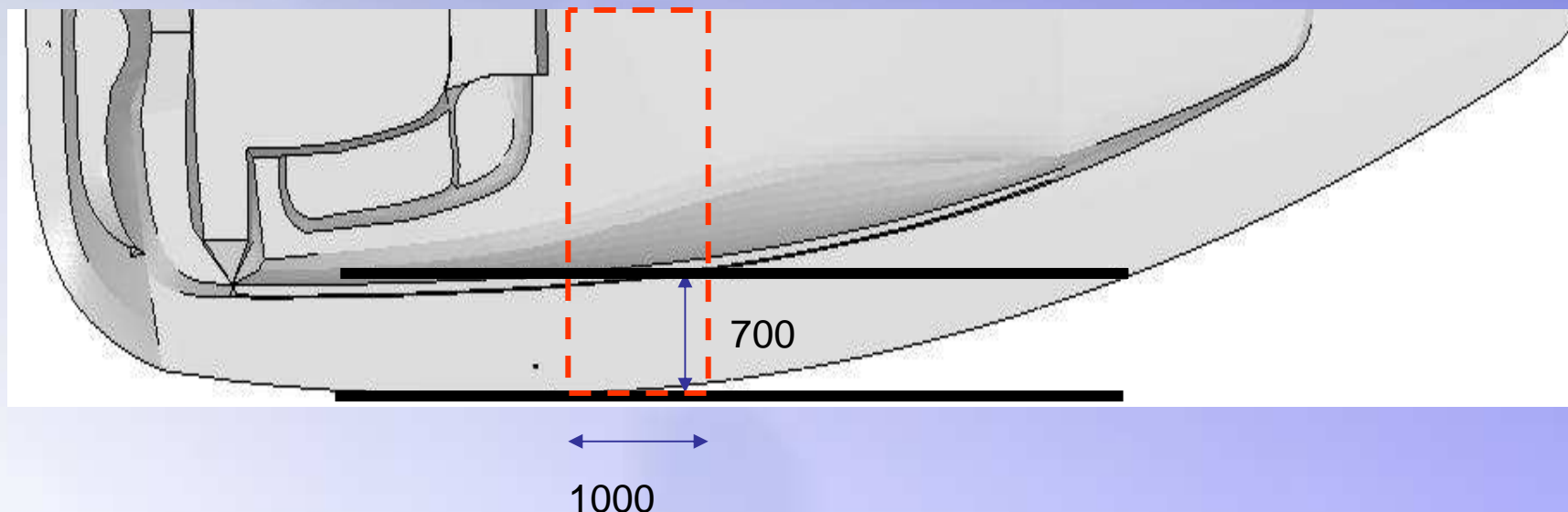


# Application case

## Boat deck



## Mechanical properties structure definition



Walking path:

Span 700mm

Central load 250kg (3 peoples)

F (total force in N) 2 500,00

b 1 000,0000 d 23,5000

t 3,5000 c 20,0000

L 700,0000

Note: length in mm

Skin material Complex 1200 g/m2 Core material Polyurethane foam 80 Kg/m<sup>3</sup>

Weight CaCo3 part 0 Safety factor 1,00

Fvc 35

Type of stress 2 single supports - concentrated load

Geometry			Materials		Stress
b	c	d	Skin	Core	Total load (in N)
1 000,0000	20,0000	23,5000	Complex 1200 g/m2	Polyurethane foam 80 Kg/m <sup>3</sup>	2 500,00
t	L	Fvc	Weight part		
3,5000	700,0000	35 %	0 %		

↓ Deflexion Stresses

	Partial bending deflexion A	Partial shearing deflexion B	Total deflexion
Deflexions f (mm)	1,5871	1,9805	3,5676

**Total deflection > 1/200th of the span !**

F (total force in N) 2 500,00

b 1 000,0000 d 23,5000

t 3,5000 c 20,0000

L 700,0000

Note: length in mm

Skin material Complex 1200 g/m2 Core material Balsa 100 kg/m<sup>3</sup>

Weight CaCo3 part 0 Safety factor 1,00

Fvc 35

Type of stress 2 single supports - concentrated load

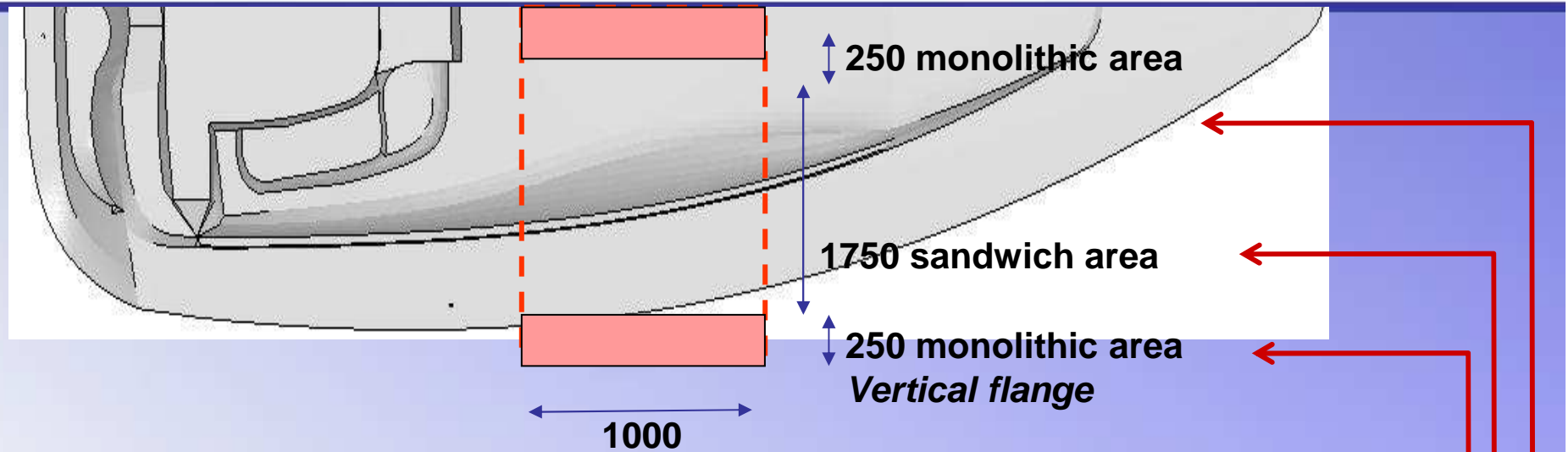
Geometry			Materials		Stress
b	c	d	Skin	Core	Total load (in N)
1 000,0000	20,0000	23,5000	Complex 1200 g/m2	Balsa 100 kg/m <sup>3</sup>	2 500,00
t	L	Fvc	Weight part		
3,5000	700,0000	35 %	0 %		

↓ Deflexion Stresses

	Partial bending deflexion A	Partial shearing deflexion B	Total deflexion
Deflexions f (mm)	1,5871	0,1584	1,7455

**Total deflection < 1/200th of the span !**

- Process simulation / Permeability  
using part description :
  - dimensions,
  - resin,
  - reinforcement
  - injection parameters (machine max flow...)



Monolithic area : 3,5mm complex / 1200gsm

Sandwich area : 2 x 3,5mm / complex 1200gsm

Geometry parameters

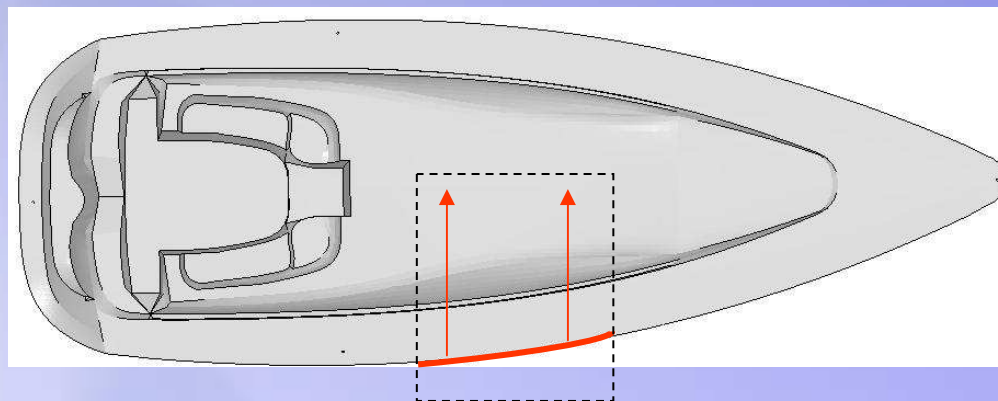
Resin: Polyester (100cP) Viscosity [cP]: 100,00

	Length (mm)	Thickness (mm)	Reinforcement	Fvc	Kx
1	250,00	3,0000	Complex 1200 g/m2	25	1.200e-09
2	2 000,00	7,0000	Complex 1200 g/m2	30	8.500e-10
3	250,00	3,0000	Complex 1200 g/m2	25	1.200e-09



- Machine max flow 10l/min for the whole boat periphery(20m)  
so for the case study(1m) **Q<sub>max</sub>=0,5l/min**
- **ΔP= 0,8 bars**

Peripheral injection,  
from OUTSIDE to INSIDE



Injection strategy

- ☐ Constant flow
- ☐ Constant pressure
- ☒ Constant flow (with PMax)

Volume to be injected(l) 10,9250

Flow rate (l/min) 0,50

Max pressure (bar) 0,80

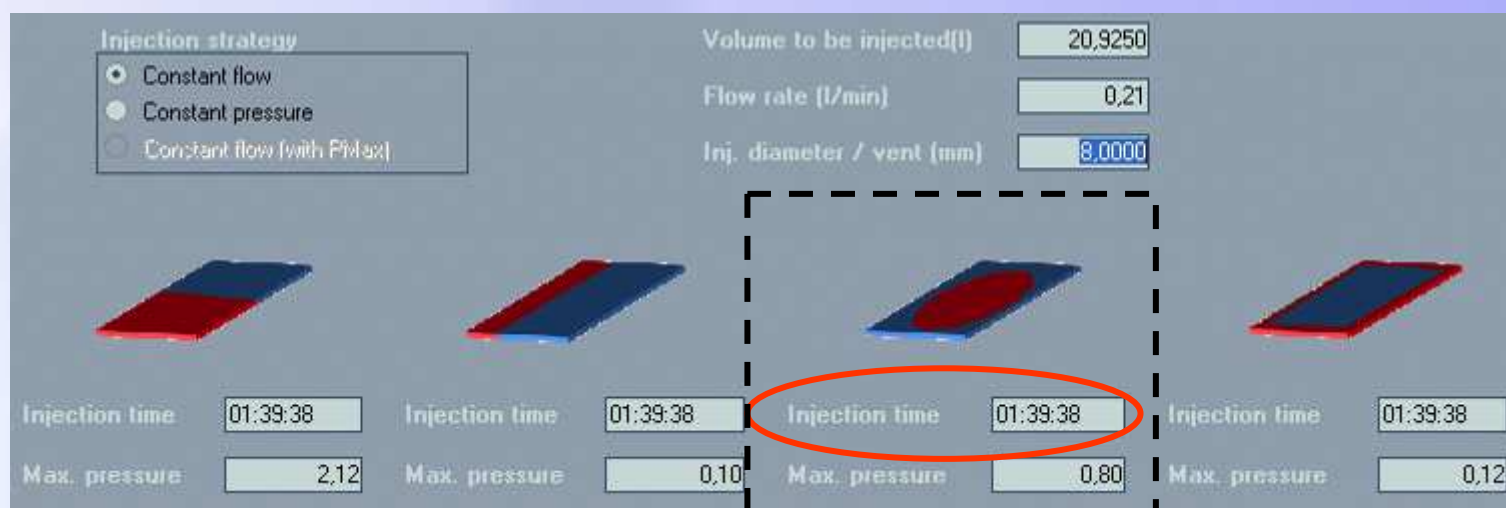
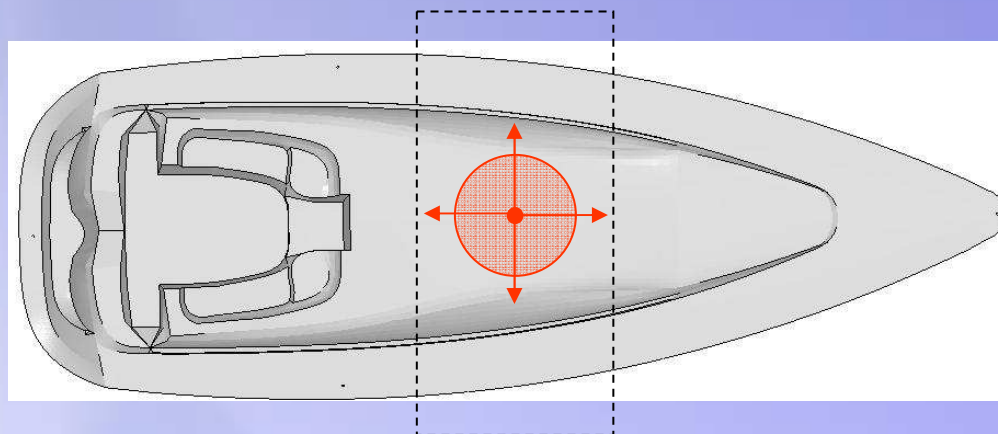
Injection time 00:55:48

Max. pressure 0,80

A 3D model of a stepped block, colored red and blue, positioned in the bottom left corner of the software interface.

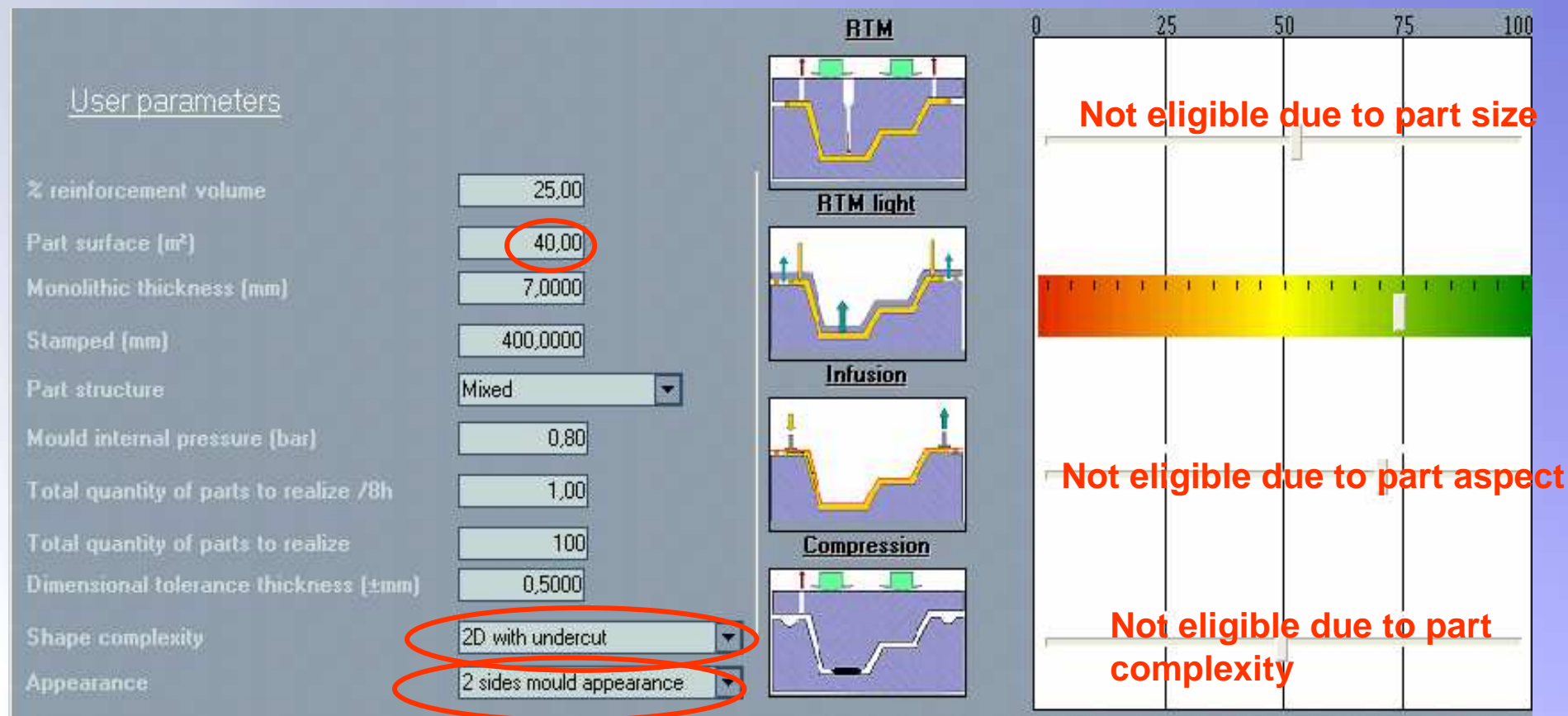
- We have to define the good flow, not to exceed **0,8bars** in mould → **Q=0,21l/min**

Central injection



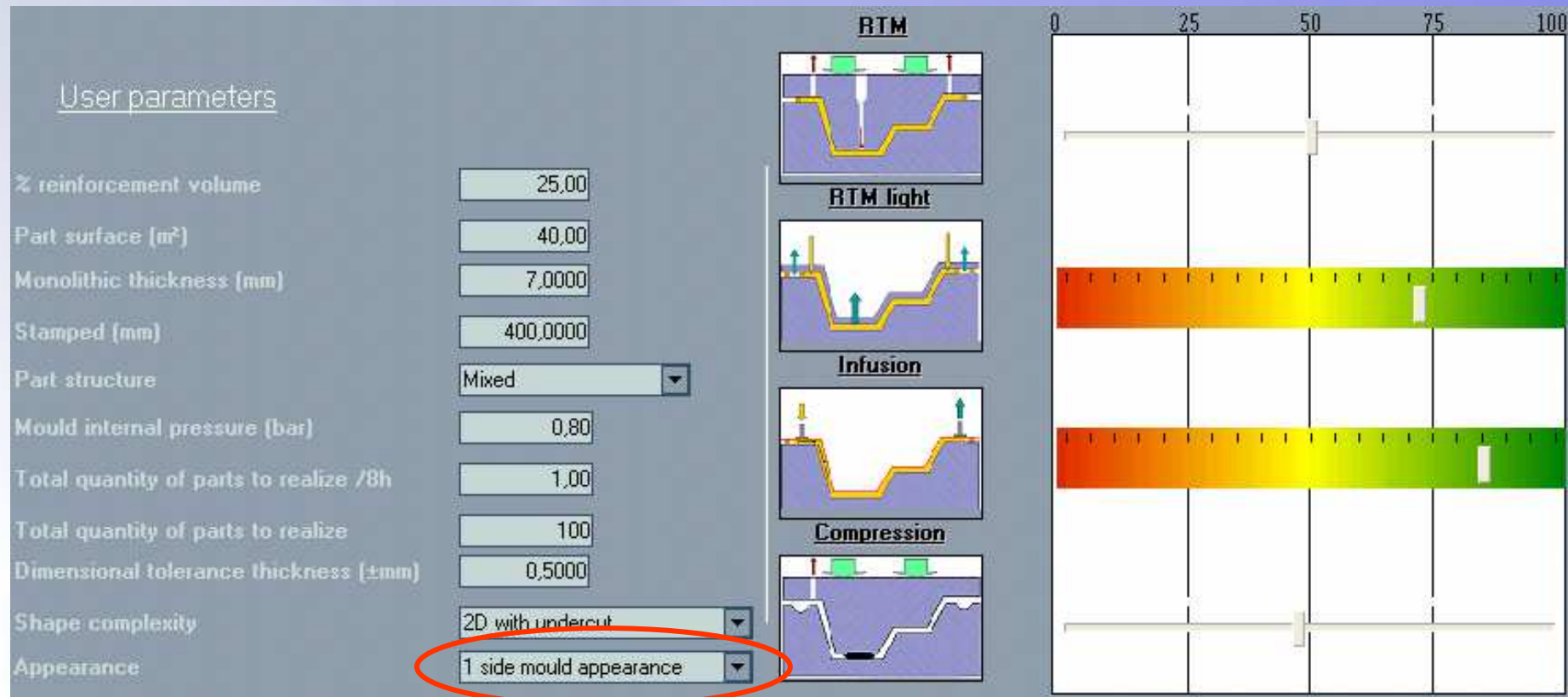
- **Process selection** depending on project inputs (part description...) and production requirements (production rate...)





With 2 aspect side => recommended process Light RTM

## Same criteria except 1 aspect side



**Recommended process: Infusion**



- **Part cost study**

# • Light RTM Cost

General Informations | **Tool equipment costs** | Equipments | Labour

Parts number	500	Qualif. labour cost (/h)	60,00	Resin cost	5,00
Surface(m²)	40,00	Direct labour cost (/h)	40,00	Filler cost	0,00
Perimeter (m)	20,00	Shift	1	Reinforcement cost	7,00
Thickness (mm)	7,0000	Inj. time + polym(min)	240,00	Core cost	216,00
Fvc	35,00	Injection time(min)	60,00	Others cost	0,00
Core volume (l)	200,0000	Reinforcement type	Glass	Post curing (min)	0,00
Filler (%)	20	Packaging (/u)	0,00		

Labour cost	573,23	Total cost/part	1 731,29
Material cost	426,00	Manufacture time/part	14:20:04
Tool cost	639,00		
Equipment cost	49,73	Global cost	865 647,19
Post operation cost	13,33	Global manufacture time	7167:20:00
Conditioning cost	30,00		

General Informations | **Tool equipment costs** | Equipments | Labour

Tool cost	60 000	Damping (Nb of parts)	100	Tool weight (kg)	1 000,00
Tool type	Composite	Moulding temperature (°C)	20,00		
Specific equipment	15 000,00	Dumping (Nb of parts)	1 000		
Release agent cost (/k)	45,00				

Infusion

Peel ply cost (/m²)	0,00	Distribution media cost (/m²)	0,00	Vacuum bag cost (/m²)	0,00
Sealant cost (/m)	0,00				

Labour cost	573,23	Total cost/part	1 707,36
Material cost	426,00	Manufacture time/part	14:20:04
Tool cost	639,00		
Equipment cost	25,80	Global cost	853 679,56
Post operation cost	13,33	Global manufacture time	7167:20:00
Conditioning cost	30,00		

General Informations | **Tool equipment costs** | Equipments | Labour

Therm. regul. cost	0,00	Vacuum pump cost	5 000,00	Compressor cost	10 000,00
Oven cost	0,00	Injection device cost	50 000,00	Mixer cost	3 000,00
Press cost	0,00	Handling material cost	50 000,00		

Labour cost	573,23	Total cost/part	1 731,29
Material cost	426,00	Manufacture time/part	14:20:04
Tool cost	639,00		
Equipment cost	49,73	Global cost	865 647,19
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Conditioning cost	30,00		

General Informations | **Tool equipment costs** | Equipments | Labour

Destocking tool (min)	120,00	Working space inst. (min)	60,00	Tool preparation (min)	120,00
Waxing time (min)	120,00	Periodicity (Nbr)	5	Gel coatage (min)	60,00
Reinfor. preparation (min)	60,00	Reinfor. lay up (min)	240,00	Resin preparation (min)	20,00
Stripping (min)	30,00	Trimming (min)	60,00	Part control (min)	30,00
Finishing (min)	30,00	Post operation (min)	20,00	Conditioning (min)	45,00

Labour cost	573,23	Total cost/part	1 731,29
Material cost	426,00	Manufacture time/part	14:20:04
Tool cost	639,00		
Equipment cost	49,73	Global cost	865 647,19
Post operation cost	13,33	Global manufacture time	7167:20:00
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- Infusion cost

General Informations **IT Tool equipment costs** Equipments Labour

Tool cost  Damping (Nb of parts)  Tool weight (kg)

Tool type  Moulding temperature (°C)

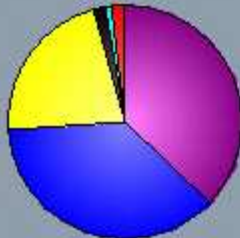
Specific equipment  Dumping (Nb of parts)

Release agent cost (/k)

**Infusion**

Peel ply cost (/m²)  Distribution media cost (/m²)  Vacuum bag cost (/m²)

Sealant cost (/m)  *Costs are not real.*



Labour cost	573,23	Total cost/part	1 561,36
Material cost	580,00	Manufacture time/part	14:20:04
Tool cost	339,00	Global cost	780 679,56
Equipment cost	25,80	Global manufacture time	7167:20:00
Post operation cost	13,33		
Conditioning cost	30,00		



## RTM Process 2 Partners



# RTM Process is available on the **ABMACO booth at FEIPLAR.**



**UPDATE YOUR AGENDA:**

**International Symposium RTM 2009**

**February 4<sup>th</sup> and 5<sup>th</sup> 2009**

**St AVOLD, FRANCE**

***With M. José A.F. MARTINS from MARCOPOLO Group, BR  
as Honorary Chairman***

- **Technical conferences**
- **Industrial success stories**
- **Workshop with live demonstrations**



**Thank you for your attention!**  
**Muito obrigado pela sua atenção!**

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