

ULTRALIGHT COMPOSITE MATERIAL NAMED

FFC *Foam
Fiber.
composite*™

BY

FRIUL  FILIERE

www.friulfiliera.it

FRIUL FILIERE S.p.A.

The new ultra light composite material named
FFC™ (Foam Fiber Composite)



Friul Filiere S.p.A. is glad to introduce the new technology, filed for patent, for the extrusion of profiles in composite material named **FFC™** (registered trade mark), obtained from PVC charged with natural fibers and lightened with closed cells expansion.



Trade Mark & Patent

Friul Filiere S.p.A. has filed a patent request for the industrial invention that covers all the aspects regarding this new technology for the production of ultra light composite material named **FFCTM** :

Formulation

Plant

Process

Product



Friul Filiere S.p.A. has registered this Trade Mark identifying the composite material result of the process.



Material data

The material consists in thermoplastic material and natural fibers. In the example presented the composite contains:

Rigid PVC : 50% to 70%

Wood Flour : 30% to 50%in weight
fibres dimension: 150 micron

These raw materials properly formulated with stabilizers, lubricators and foaming agents are mixed to obtain an homogeneous compound ready to be extruded directly on extruding lines equipped with single screw or counter-rotating twin screw extruders.

Advantages

- **SPECIFIC WEIGHT = 0.65 g./cm³** similar to wood
- **LOWER COST** comparing all the other materials
- **ECONOMICAL AND SIMPLIFIED PRODUCTION PROCESS:** it has a prerogative to be extruded directly from dry blend avoiding the granulating process and using the new single screw extruders Omega series 28
- **SIGNIFICANT COST REDUCTION OF THE FINISHED PRODUCT**
- **HIGH PRODUCTIVITY**



Advantages

WORKABLE AS WOOD:

- Drilling
- Screwing
- Milling
- Riveting



Advantages

- **RECYCLABLE:** re- grindable and re-usable in the extrusion of the same material or other PVC compounds
- **SELF EXTINGUISHING PRODUCT**
- **DIMENSIONAL STABILITY**
- **DUMP RESISTANCE:** water absorption is avoided since the PVC is water repellent and coats the wood fibers
- **FLEXIBILITY:** applicable on bended surfaces
- **THERMAL INSULATION**
- **ACOUSTIC INSULATION**



A technology applicable to several fields, from the building to the agriculture sector, with outstanding results. The final products achieved are highly competitive comparing to the materials nowadays used.



Alternative materials comparison

With the purpose to explain the potential of the new technology, we compare **FFC™** with other competitive products: **MDF** (Medium density fiberboard), **STANDARD WOOD**, **WPC** (Wood Plastic Composite), **RIGID PVC**, **FOAM PVC** as:

- Raw material cost and specific weight
- Processing or mechanization
- Finishing
- Indicative selling price

Comparative m³ cost of different formulations

MDF



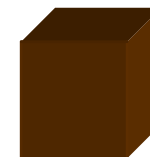
1m³= 700 kg
1m³= 300 €
1kg = 0,43 €

PVC



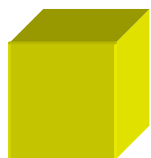
UPVC: 1m³= 1500 kg
1m³= 1800 €
1kg = 1,2 €
XPVC: 1m³= 650 kg
1m³= 775 €
1kg = 1,19 €

WPC - PVC



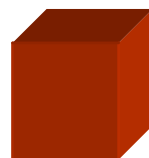
1m³= 1600 kg
1m³= 1040 €
1kg = 0,65 €

WOOD standard



1m³= 700 kg
1m³=1400 €
1kg = 2,0 €

WPC PE/ PP



1m³= 1200 kg
1m³= 1200 €
1kg = 1,0 €



1m³= 650 kg
1m³= 578 €
1kg = 0.89 €

Processing

The processing cost will be conveniently estimated the same for all the materials, since some kind of processing, although different, is carried out in all the cases:

- **FFC™**; RIGID PVC, FOAM PVC, WPC-PVC and WPC-PE/PP must be mixed and extruded;
- STANDARD WOOD and MDF must be machined with tools starting from boards and panels;



Comparative processing costs

A) Mixing cost :


Manpower	= 0,05 €/kg
Energy + water	= 0,10 €/kg
Plant depreciation	= 0,06 €/kg
TOTAL	= 0,21 €/kg

B) Extrusion cost :

Manpower	= 0,10 €/kg
Energy + water	= 0,05 €/kg
Plant depreciation	= 0,06 €/kg
TOTAL	= 0,21 €/kg

C) Machining cost :

Moulding	
Polishing	
TOTAL	= 0,2 €/kg

	Dry blend	PROCESSING TOTAL COST * <small>.FFC estimate based on 500 kg/h production using no. 5 extruding lines</small>	= A+B	= 0,42 €/kg
WPC-PVC	Dry blend	Processing Total Cost	= A+B	= 0,42 €/kg
WPC-PE/PP	Granule	Processing Total Cost	= B	= 0,21 €/kg
RIGID PVC	Dry blend	Processing Total Cost	= A+B	= 0,42 €/kg
FOAM PVC	Dry blend	Processing Total Cost	= A+B	= 0,42 €/kg
WOOD	Boards	Machining Total Cost	= C	= 0,20 €/kg
MDF	Boards	Machining Total Cost	= C	= 0,20 €/kg

Superficial finishing

FFC™ ; RIGID PVC:
WPC-PVC
WPC HDPE-PP
FOAM PVC

finishing with HOT STAMPING,
WRAPPING or PAINTING,
LACQUERING are required.

WOOD:

PAINTING, LACQUERING is
required.

MDF:

finishing with HOT STAMPING;
WRAPPING or PAINTING,
LACQUERING are required.



PAPER SUPERFICIAL FINISHING

Wrapping finishing:

The same cost for **FFC™** and for all the materials =

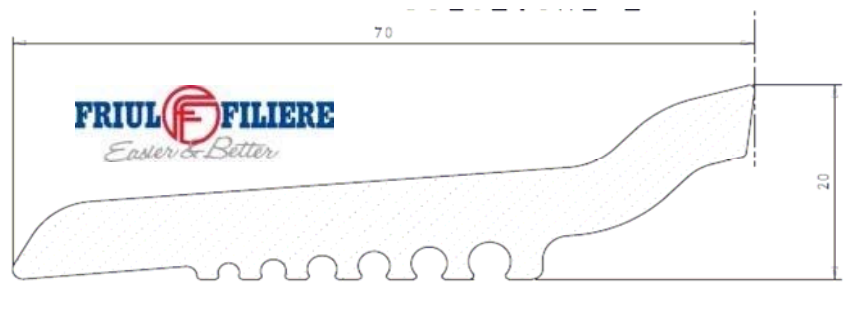
0,320 €/ml

(manpower included)



Case study

Comparison



example: skirting profile

Plastic materials: finished product area	: 513 mm ²
Wood, MDF: uncut area 70x21mm	: 1470 mm ²

Raw material comparative cost

example: skirting profiles



(formulation cost)

334 gr/ml

578 €/m³:650 kg=0,89 €/kg

334 gr/mlx0,89 €/kg :1000= 0,30 €/ml

MDF (panel 70x21 mm)

70x21x0,7=1030 gr/ml

300 €/m³ :700 kg=0,43 €/kg

1030 gr/mlx0,43 €/kg:1000=0,443 €/ml

WOOD

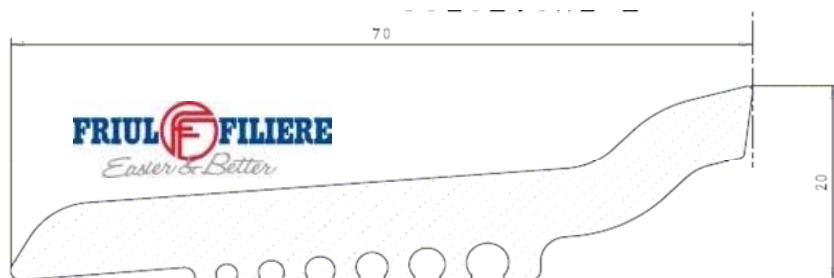
70x21x0,7=1030 gr/ml

1400 €/m³ :700 kg=2 €/kg

1030 gr/mlx2 €/kg:1000= 2,06 €/ml

Raw material comparative cost

example: skirting profiles



(formulation cost)

334 gr/ml

578 €/m³:650 kg=0,89 €/kg

334 gr/mlx0,89 €/kg :1000= 0,30 €/ml

WPC-PVC

513x1.6 =820 gr/ml

1040 €/m³ :1600 kg= 0,65 €/kg

820 gr/mlx0,65 €/kg:1000=0,53 €/ml

WPC-HDPE-PP

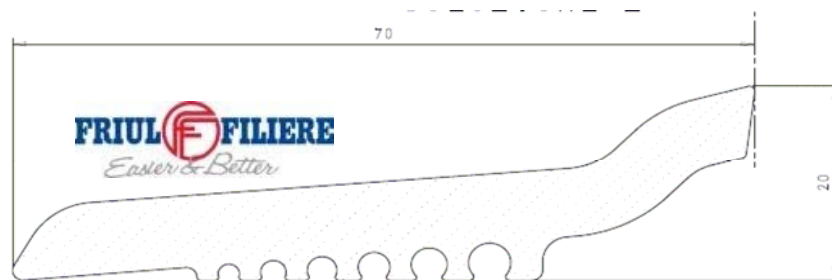
513x1.2 = 615 gr/ml

1200 €/m³ :1200 kg= 1 €/kg

615 gr/mlx1 €/kg:1000= 0,615 €/ml

Raw material comparative cost

example: skirting profiles



(formulation cost)

334 gr/ml

578 €/m³:650 kg=0,89 €/kg

334 gr/mlx0,89 €/kg :1000= 0,30 €/ml

RIGID PVC

513x1,5= 770 gr/ml

1800 €/m³:1500 kg=1,2 €/kg

770 gr/mlx1,2 €/kg:1000=0,92 €/ml

FOAM PVC

513x0,65= 334 gr/ml

775 €/m³ : 650 kg= 1,19 €/kg

334 gr/mlx 1,19 €/kg:1000= 0,40 €/ml




Processing costs

example: skirting profiles

A) *Mixing cost* = 0,21 €/kg B) *Extrusion cost* = 0,21 €/kg C) *Machining cost* = 0,2 €/kg


Total processing cost (€/kg) x profile weight (kg./ml) = cost (€/ml)

	= A+B	= 0,42 €/kg	x	0,334 kg/ml	= 0,14 €/ml
WPC-PVC	= A+B	= 0,42 €/kg	x	0,820 kg/ml	= 0,34 €/ml
WPC-PE/PP	= B	= 0,21 €/kg	x	0,615 kg/ml	= 0,13 €/ml
RIGID PVC	= A+B	= 0,42 €/kg	x	0,770 kg/ml	= 0,32 €/ml
FOAM PVC	= A+B	= 0,42 €/kg	x	0,334 kg/ml	= 0,14 €/ml
WOOD	= C	= 0,20 €/kg	x	1,030 kg/ml	= 0,21 €/ml
MDF	= C	= 0,20 €/kg	x	1,030 kg/ml	= 0,21 €/ml




Raw material comparative cost

example: skirting profiles

	Raw material cost €/ml	Processing cost €/ml	Profile cost €/ml	Profile cost Δ %
	0,30	0,14	0,440	
MDF	0,443	0,21	0,653	+48%
WOOD	2,06	0,21	2,270	+416%
RIGID PVC	0,92	0,32	1,240	+182%
FOAM PVC	0,4	0,14	0,540	+23%
WPC-PVC	0,53	0,34	0,870	+98%
WPC-PE/PP	0,615	0,13	0,745	+69%


Production comparative cost

example: finished skirting profiles

			MDF
a) Profile cost	=	0,440 €/ml	0,653 €/ml
b) Finishing	=	0,320 €/ml	0,320 €/ml
TOTAL a) + b)	=	<u>0,760</u> €/ml	<u>0,973</u> €/ml


Selling price estimate

example: skirting profiles

	 FFC Foam Fiber composite™	MDF
Manufacturing cost =	0,760 €/ml	0,973 €/ml
Overhead cost (20%) =	0,152 €/ml	0,194 €/ml
Profit margin (20%) =	0,152 €/ml	0,194 €/ml
TOTAL =	1,064 €/ml	1,361 €/ml

Selling prices: comparison

example: skirting profiles

	Raw material cost	Processing cost	Total profile cost	Total profile cost with finishing (+0.320 €/ml)	Total indicative selling price (+20% +20%)	Indicative selling price
	€/ml	€/ml	€/ml	€/ml	€/ml	Δ %
	0,30	0,14	<u>0,440</u>	<u>0,760</u>	<u>1,06</u>	
MDF	0,443	0,21	<u>0,653</u>	<u>0,973</u>	<u>1,36</u>	+28%
WOOD	2,06	0,21	<u>2,270</u>	<u>2,590</u>	<u>3,63</u>	+241%
RIGID PVC	0,92	0,32	<u>1,240</u>	<u>1,560</u>	<u>2,18</u>	+105%
FOAM PVC	0,40	0,14	<u>0,540</u>	<u>0,860</u>	<u>1,20</u>	+13%
WPC-PVC	0,53	0,34	<u>0,870</u>	<u>1,190</u>	<u>1,67</u>	+57%
WPC-PE/PP	0,615	0,13	<u>0,745</u>	<u>1,065</u>	<u>1,49</u>	+40%

Physical - mechanical characteristics comparison:

	FFC	MDF	WOOD	RIGID PVC	WPC-PVC	WPC PE/PP	FOAM PVC	NORMS
% Wood	30	93	100	0	50	60	0	-
Specific weight	0,65	0,7	0,7	1,5	1,6	1,2	0,65	AST MD 792
Absorption H2O%	0,28	5	3	0,05	0,15	0,1	0,28	AST MD 570
Elastic Modulus	2.000	8.000	40.000	2500	2.800	1.500	1.300	AST MD 790
Temperature Vicat	83	-	-	83	83	95	80	AST MD 525
Superficial hardness SHORE A	100	>100	100	100	100	100	100	AST MD 676
Inflammability	Self extinguishing V0	inflammable	inflammable	Self extinguishing V0	Self extinguishing V0	inflammable	Self extinguishing V0	UL 94 V
Thermal transmittance	0,13 W/(mK)	0,12 W/(mK)	0,15 W/(mK)	0,15 W/(mK)	0,12 W/(mK)	0,15 W/(mK)	0,17 W/(mK)	AST MD 2326
Hot shrinkage %	0,2	0,05	0,05	2	0,5	0,5	1	AST MD 696
Thermal linear dilatation	10⁻³ mm/° C	in test	in test	in test	in test	in test	in test	

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Complete Know-how for the production of profiles in the new ultra light composite material named

FFC™ (Foam Fiber Composite)



Friul Filiere S.p.A. supplies the “turn key project” from the raw material to the finished product:

- Formulation
- Turn key project complete with:
 1. Drying system
 2. Loading and Dosing system
 3. Mixing system
 4. Extruding lines and dies

Material data

The material consists in thermoplastic material and natural fibers. In the example presented the composite contains:

Rigid PVC : 50% to 70%

Wood Flour : 30% to 50% in weight
fibers dimension: 150 micron

Finished product specific weight: 0.65 g./ cm³

01. Drying System

The Drying unit is studied to take away part of the moisture naturally included in natural fibers using a hot air insufflation with air recycle and Cyclone filter.

Wood sand capacity: 200 kg/h

Heating capability: 16 kW

Wood sand transportation by air blower

Fire system with photocell

02. Loading and Dosing system

The Loading and Dosing system is studied to automatically transport and weight the materials (dry blend, wood sand, additives) from the dedicated silos to the mixing system, where the batches are prepared:

Pneumatic under vacuum material transport

Dedicated scales

Final conveyor to the extruders

03. Mixing System

The Mixing system consists in a Mixing unit and a Cooler, where the materials, weighted following **FFCTM** formulation, are mixed and cooled down:

Production capacity: 5 batches/hour for 100 kg/batch

04. Extruding lines

The extruding lines can be equipped with:

Single screw extruders series Omega 28 or
Counter rotating twin screw extruders

Downstream series Omega S: S1; S2; S3

Dies and calibrating system





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Patent licence

In all the cases, the listed costs must be added to the cost related to the acquisition of **FFC™** Know-How as for “licence agreement” to be stipulated between the parties.

Against the agreed sum, Friul Filiere S.p.A. sells the right to exploit economically the Patent, the Know-How and the Trade Mark as for contractual obligations.

Friul Filiere S.p.A. will restrict this utilization in length of time and for a certain territory. After a case by case evaluation, depending on the type of use of the patent, Friul Filiere S.p.A. will require, as money consideration, a fixed lump sum, independently from the profits realized by the third party.