



## Deliverable n° D3.2

### Green worktops Type 2-3 test report and pictures

#### Summary:

One of LIFE GREEN COMPOSITE's objectives is the development of new panels for worktops from recycling of sink waste, powders and dusts from sink production, with other composite, fiberglass and rigid foam waste.

The purpose of Deliverable D3.2 is to report the results of production trials and evaluation tests relating to the production of Green worktops Type 2 and 3, which involves the incorporation of DELTA's sink waste together with other waste already used by GEES, plus the use of Delta R-PMMA as coating or outer layer of material.

A new type of panel, the Type 4 was also developed to obtain a different aspect and quality product. The production trials and related evaluation tests are documented by a photo report. Very satisfactory results have been achieved especially for this last Type 4, whose development can be considered as an integration with correction of the other types of panels.

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|                  |                                                                                                                                                                                            |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Project acronym: | LIFE21-ENV-IT-LIFE GREEN COMPOSITE                                                                                                                                                         |
| Project title:   | Greening kitchen sinks and worktops: exploiting industrial symbiosis to produce acrylic mineral composites from recycled and tracked production waste in a replicable circular value chain |

|                            |                                                                                                        |
|----------------------------|--------------------------------------------------------------------------------------------------------|
| Grant Agreement number:    | 859087                                                                                                 |
| Call identifier:           | LIFE-2021-SAP-ENV                                                                                      |
| Start date of the project: | 01/08/2022                                                                                             |
| Duration:                  | 36 months                                                                                              |
| Website:                   | <a href="#">EU Funding &amp; Tender Portal</a><br><a href="#">Geesrecycling – life green composite</a> |



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## SUMMARY

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## 1. Executive summary

The basic idea pursued by Gees Recycling S.r.l. (hereafter GEES) in partnership with Delta S.r.l. (hereafter DELTA) within the framework of the LIFE GREEN COMPOSITE project is to create a pathway to utilize composite sink waste, while improving the quality of the worktops and panels already produced by GEES with other waste materials.

GEES' strategy aims to strengthen the circular economy, already the basis of its production, through the industrial symbiosis initiated with DELTA, focusing on the following objectives:

- ♣ Create recycling routes for Delta sink waste not reusable by Delta itself and for other solid surfaces materials
- ♣ Create new kitchentops from circular economy and recycling instead of using non-renewable resources
- ♣ Introduce 'green resins' for the production of solid colours panels
- ♣ Demonstrate the use of R-PMMA as coating or surface layer in alternative to other synthetic virgin products

The expected results are: finished products like worktops, panels and other furniture components.

The purpose of Deliverable D3.2 is to report the results of production trials and evaluation tests relating to the production of Green worktops Type 2 and 3, two of the three types of panels to be developed in the project. The new production line includes the incorporation of DELTA's sink scraps together with other scraps already used by GEES, plus the use of Delta R-PMMA

Further work and development lead to the creation of an entire new line of panel, Type 4, obtained by mixing selected sink waste and low-density PMI Rigid foam powders and/or glass microcapsule, the development of which can be considered as an integration with correction of the other types of panels.

Results are valuable and lead to new products with appreciated by market qualities, also confirming the competitiveness of >90% recycled materials - coating included - respect the traditional virgin sourced.

## 2. Introduction

Recycling composites is to date a complicated process, and this applies even more for mineral-filled composite. It is impossible to separate the organic part from the inorganic part, as they are chemically bound to achieve the highest mechanical properties.

At the same time, the use of recycled materials in the manufacturing of acrylic mineral composites is still limited, due to the complex processing techniques, that are very dependent on extremely pure materials.

In Europe, about 1,5 Million kitchen sinks are yearly produced in this material, showing an increasing appreciation by consumers due to their particular properties.

About 17 % of the overall production constitutes waste: considering an average weight of 14 kg per sink, this implies that in Europe yearly 21.000 ton of raw materials are used for the production of these kitchen sinks, producing an amount of waste of about 3.654 ton. These scraps and refuses are for about 98 % landfilled as

special industrial waste (cod. CER 070213 plastic waste), consisting in mineral waste heavily polluted by polymers.

LIFE GREEN COMPOSITE aims to reduce such industrial waste by demonstrating on a pilot and industrial scale circular solutions for the reuse of acrylic mineral composite waste and the production of such composites from secondary raw materials.

### 3. Preparatory operations

It was necessary to install additional equipment to do the project work , an Hydraulic press where to do the numerous production tests outside of the production line , with higher platen temperatures to process different resins

- Laboratory - pilot press , with 1000 x 650 mm platen , 300 T hydraulic power and temperature regulable up to 200 C°

Gees has completed these operations; the equipment installed worked and results are confirming expectations.



Figure 1 - laboratory press during test productions

### 4. Type of materials developed for worktops and panels

Deliverable D3.2: Green worktops Type 2 and 3 test report and pictures



GEES RECYCLING is using its proprietary technology to test new mixtures of very different raw materials, developing new recycled composites with specific performance and characteristics such as low density, water resistance, impact and stain resistance, UV behavior and antibacterial qualities by mixing additives or active components

In the context of LGC project, three types of panels are planned for production, all three consisting of secondary raw materials >90%, sourced through a circular supply chain, but with different Delta - sink waste contents:

- Type 1 - Grained panel, Monolayer: Composed of 70% Delta sink waste (0,6-6 mm), 25% various polysterenes and fibreglass waste from wind turbine blades, 5% polyurethane resin; Representing top quality product, with high density, that can be milled and worked as a natural stone, with possibility of having much thicker slabs respect actual products. This quality is referred to as TYPE 1 worktop.
- Type 2 - Solid colour panel, Multilayer: Composed of a visible layer (20%) and an invisible layer (80%). The invisible layer will have the similar composition as the grained panel but will be coated with 100% recycled material (DELTA dispersion) The 100% recovery resin is from Delta, that is studied for the new applications for GEES Medium quality product –(reduced density)
- Type 3 - Solid colour panel Monolayer: Composed of a visible layer (20%) and an invisible layer (80%). The invisible layer consists of 95% various lightened polyester scraps, glass fibre and PVC; 5% polyurethane resin Resulting in a Lower quality slab with low density. Outer surface in sink waste composite/dispersion green? and inner core in recycled low-density rigid foam, to be placed on market that is currently dominated by wood-particle laminates

We have added a new family of panels, where the sink waste is mixed with low density powders from PMI Foam (Rohacell) in two versions:

- Grained color mass medium density
- Grained color mass high density

The target – indicated by the market demands of the customers, was to obtain a “natural stone” look with high variability and color and grain similar throughout the mass to allow for 3D shapes obtained by CNC milling; we have defined these new panels as Type 4.

## 5. Green worktops Type 2

### 5.1 Composition

The “Type 2” panel production was tested within the framework of WP3 (Task 3.2); this is the multilayer panel composed of a visible layer coated with R-PMMA resin on a support made of high-density recycled composites.

One of the most interesting aspects of Type 2 panels using the R-PMMA coating is the possibility of creating extremely transparent high-thickness coating, which also allow the incorporation of different substances for aesthetic purposes.

|                                    |           |                                                                |
|------------------------------------|-----------|----------------------------------------------------------------|
| SOLID PANEL MULTILAYER<br>(TYPE 2) | 70%       | DELTA sink waste                                               |
|                                    | 15%       | Various polyester + glass fiber waste from wind turbine blades |
|                                    | 5%<br>10% | Polyurethane resin<br>R-PMMA Coating                           |

Table 1: Type 2 worktop composition

Incoming waste: like all the waste we recycle, these have also been tested according to the law to be declared non-hazardous. The waste component derived from sinks for Type 2 worktop (70%) is obtained from mechanical granulation of defective sinks and waste parts, resulting in:

70 % Sink waste , of which

- 40 % Shredded sinks
- 30% Dust and powder

Source materials and different process stage of raw materials:



(a) Waste sinks

(b) Sink fragments

(c) Granulated sinks

(d) Dust and powder

The component derived from other industrial waste (15%) is in part derived from industrial fiberglass waste, in part from rigid foam waste:

15% Other composite waste , of which

- 5 % Fiberglass from industrial and wind Blades



(e) Fiberglass from industrial waste and wind Blades (f) low density rigid foam

Production tests confirmed this composition.

## 5.2 Production trials and evaluation

GEES conducted a few production trials for the transformation of waste mixtures into rigid panels of TYPE 2.

- 3 different production tests were carried out:
  - 201.14 October 2023 lot # 105 – Thickness 20 mm + 5 mm D. 1050
  - 202.18 December 2023 lot # 211 – Thickness 20 mm +3 mm D. 1055
  - 204.19 April 2024 lot # 298 – Thickness 20 mm +3 mm D. 1055

All the materials produced were then tested to evaluate the results according to a standard procedure:

1. Density calculation and verification of average deviation – tools : scale and calibre
2. Planarity verification- tools: rectified planarity bench , calibre
3. Surface roughness and porosity – tools : magnifying lens

Test results are reported here following:

- 201.14 October 2023 lot # 105 – Thickness 20 mm + 5 mm D. 1050
  - Density average : 1050 , lowest 1010 highest 1112 result in tolerances
  - Planarity : Good : < 3 mm over 2500 mm lenghtwise . < 2 mm broadwise
  - Surface roughness : rough Surface with porosity
- 202.18 December 2023 lot # 211 – Thickness 20 mm +3 mm D. 1055
  - Density average : 1055 , lowest 1001 highest 1080 result in tolerances
  - Planarity : bad : > 5mm over 2500 mm lenghtwise . > 3,5 mm broadwise
  - Surface roughness : bad, evident porosity
- 204.19 April 2024 lot # 298 – Thickness 20 mm +3 mm D. 1055
  - Density average : 1055 , lowest 1001 highest 1080 result in tolerances
  - Planarity : Good : < 3 mm over 2500 mm lenghtwise . < 2 mm broadwise

- Surface roughness : Good , no evident porosity, natural hydrophobicity

## Life Green Composite      Production tests Type 2

| Test # | Period   | Lot # | Thickness | Density avg | Density Max | Density min | In tolerance | Planarity | Surface | Edge |
|--------|----------|-------|-----------|-------------|-------------|-------------|--------------|-----------|---------|------|
| 201.14 | Oct 23   | 105   | 20+5      | 1055        | 1112        | 1010        | Yes          | <3        | Good    | Good |
| 202.18 | Dec 23   | 211   | 20+3      | 1055        | 1080        | 1155        | Yes          | >5        | Bad     | Bad  |
| 204.19 | April 24 | 298   | 20+3      | 1055        | 1080        | 1001        | Yes          | <3        | Good    | Good |

204.19 lot #298 is the best result and will be taken as base for further developments. This panel was submitted to mechanical tests and surface resistance tests as foreseen in Task 3.4.

204.19 lot #298 was also submitted to a flame test; results were encouraging as no flame propagation occurred, little smoke and no droplets were observed.

A strong self-extinguishment was noted that lead us to carry out official flame behaviour tests following EN 13501 FL (see picture 5 in § 5.7).

The potential customers after the first deliveries of Life Green Composite obtained panels told us of no importance given to Tensile strength tests, since the kitchentops applications are more similar to stone; resistance to cold liquids , where the tests on chemicals substances and cleaning products are more significant for markets ; heat resistance is also a required characteristic; so we chose to perform the requested test and not the others.

### 5.3 External test report: Mechanical performance from laboratory testing report

Test Report 385321 / 1: Flexural properties on Panel Type 2 Lot 298



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Testing Certification Research

# TEST REPORT

385231 / 1

Revision: 0  
Date of sample receipt: 29/11/24  
Date of test: 18/12/24  
Date of issue: 23/12/24

GEES RECYCLING S.R.L.  
VIA MONTE COLOMBERA 22  
33081 AVIANO (PN)  
ITALIA

Sample name: Pannello Life Green Composite.

## Plastics - Flexural properties UNI EN ISO 178:2019

Sample description: Not declared  
Test method: A (one speed of testing)  
Nominal thickness: 21 mm  
Support span: 336 mm  
Specimen preparation: Performed by the customer  
Test direction: Not identifiable Specimen shape: Parallelepiped  
Conditioning: > 72 h (23±2 °C and 50±5% r.h.) Testing temperature: 20±5°C  
Testing equipment: Instron dynamometer mod. 5585 Test speed: 5 mm/min  
Tested surface: Not identifiable

### Risultati della prova:

| Specimen<br>n°     | Width<br>mm | Thickness<br>mm | Maximum load<br>N | Flexural strength<br>MPa | Modulus of<br>elasticity<br>MPa |
|--------------------|-------------|-----------------|-------------------|--------------------------|---------------------------------|
| 1                  | 19,7        | 21,33           | 169               | 9,5                      | 3.105                           |
| 2                  | 19,2        | 21,04           | 161               | 9,5                      | 2.864                           |
| 3                  | 19,8        | 21,33           | 210               | 11,7                     | 3.345                           |
| 4                  | 20,3        | 21,04           | 138               | 7,7                      | 2.911                           |
| 5                  | 19,1        | 21,34           | 163               | 9,4                      | 3.437                           |
| 6                  | 20,4        | 21,34           | 208               | 11,3                     | 3.400                           |
| 7                  | 19,6        | 21,04           | 130               | 7,6                      | 2.476                           |
| Mean Value         |             |                 |                   | 9,5                      | 3.077                           |
| Standard deviation |             |                 |                   | 1,6                      | 351                             |

### Notes:

- Test ref. declared by the customer: Progetto 101074703-LIFE21-ENV-IT LIFE GREEN COMPOSITE
- Chemical analysis of the tested material has not been carried out.
- The company who asked for the test has collected and sampled the specimens.

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## Test Report 385321 / 2: Compression properties Panel lot 298 / Uncoated, thickness 20 mm uncalibrated

|                                                                                                                                                                                                                                                            |          |                                                                                                                                                                                                                           |                |                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------|
|                                                                                                                                                                           |          | CATAS S.p.A. Testing site: via Antica, 24/3 via<br>Antica, 24/3<br>33048 San Giovanni al Nat. (UD) 33048 San Giovanni al Nat. (UD)<br>+39 0432 747211 - lab@catas.com tel. +39 0432 747211<br>www.catas.com lab@catas.com |                |                          |
| <b>TEST REPORT</b><br><b>385321 - 2</b><br>Revision: 0<br>Date of sample receipt: 29/11/24<br>Date of test: 17/12/24<br>Date of issue: 23/12/24                                                                                                            |          | <b>GEES RECYCLING S.R.L.</b><br><b>VIA MONTE COLOMBERA 22</b><br><b>33081 AVIANO (PN)</b><br><b>ITALIA</b>                                                                                                                |                |                          |
|                                                                                                                                                                                                                                                            |          | Sample name: Pannello Life Green Composite.                                                                                                                                                                               |                |                          |
| <b>Plastics - Compressive strength UNI EN ISO 604:2008</b>                                                                                                                                                                                                 |          |                                                                                                                                                                                                                           |                |                          |
| Sample description declared: Not declared                                                                                                                                                                                                                  |          |                                                                                                                                                                                                                           |                |                          |
| Specimen shape and load direction: Parallelepiped and a compressive load is applied on the specimen surface                                                                                                                                                |          |                                                                                                                                                                                                                           |                |                          |
| Nominal thickness: 21 mm                                                                                                                                                                                                                                   |          |                                                                                                                                                                                                                           |                |                          |
| Conditioning: > 72h (23±2 °C and 50±5 % r.h.)                                                                                                                                                                                                              |          | Test conditions: 23±2 °C and 50±5 % r.h.                                                                                                                                                                                  |                |                          |
| Test equipment: Instron dynamometer mod. 5985                                                                                                                                                                                                              |          |                                                                                                                                                                                                                           |                |                          |
| Load applicators: Steel plates (Ø 150 mm)                                                                                                                                                                                                                  |          |                                                                                                                                                                                                                           |                |                          |
| Test speed: 2 mm/min                                                                                                                                                                                                                                       |          |                                                                                                                                                                                                                           |                |                          |
| <b>Test results:</b>                                                                                                                                                                                                                                       |          |                                                                                                                                                                                                                           |                |                          |
| Specimen n°                                                                                                                                                                                                                                                | Width mm | Length mm                                                                                                                                                                                                                 | Maximum load N | Compressive strength MPa |
| 1                                                                                                                                                                                                                                                          | 20,26    | 19,98                                                                                                                                                                                                                     | 13.451         | 33,2                     |
| 2                                                                                                                                                                                                                                                          | 20,44    | 20,04                                                                                                                                                                                                                     | 15.270         | 37,3                     |
| 3                                                                                                                                                                                                                                                          | 20,41    | 20,43                                                                                                                                                                                                                     | 15.351         | 36,8                     |
| 4                                                                                                                                                                                                                                                          | 19,92    | 20,11                                                                                                                                                                                                                     | 14.573         | 36,4                     |
| 5                                                                                                                                                                                                                                                          | 20,52    | 19,78                                                                                                                                                                                                                     | 15.494         | 38,2                     |
| 6                                                                                                                                                                                                                                                          | 20,32    | 20,12                                                                                                                                                                                                                     | 13.847         | 33,9                     |
| 7                                                                                                                                                                                                                                                          | 19,30    | 19,91                                                                                                                                                                                                                     | 12.803         | 33,3                     |
| 8                                                                                                                                                                                                                                                          | 20,49    | 19,32                                                                                                                                                                                                                     | 15.074         | 38,1                     |
| <b>Mean value</b>                                                                                                                                                                                                                                          |          |                                                                                                                                                                                                                           |                | <b>35,9</b>              |
| Standard deviation                                                                                                                                                                                                                                         |          |                                                                                                                                                                                                                           |                | 2,1                      |
| Coeff. of var.                                                                                                                                                                                                                                             |          |                                                                                                                                                                                                                           |                | 5,8 %                    |
| Notes:<br>- Test ref. declared by the customer: Progetto 101074703-LIFE21-ENV-IT LIFE GREEN COMPOSITE- Chemical analysis of the tested material has not been carried out.<br>- The company who asked for the test has collected and sampled the specimens. |          |                                                                                                                                                                                                                           |                |                          |

  
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A note on tests results: the Thickness of the panels was 22 mm for the uncalibrated panel, reduced to 21 mm after calibration; variations on thickness are intrinsic to the process and recycled content.

### 5.4 External test report: Resistance to stains, chemicals and cleaning products

The use as Kitchentop or table top material requires to have a good resistance to the events may happens like stains of any food product, liquids acids or basic and cleaning products.

Tests were done by Delta using standard procedures for kitchen sinks (higher requirements respect kitchentops):

Deco LGC with Acrylic Monocomponent Coating , test result 06/2024 Panel Type 2 Lot#298

Here are some excerpts from tests results from DELTA.

### DELTA TECHNICAL REPORT D-02/2024

Object: *Deco LGC Acrylic Monocomponent Coating*

Testing of chemical resistance:

| SUBSTANCE                                                       | TYPE            |
|-----------------------------------------------------------------|-----------------|
| 1. Acid acetic (CH <sub>3</sub> COOH), 10% V/V                  | Acid            |
| 2. Sodium Hydroxide (NaOH), 5% m/m                              | Alkali          |
| 3. Etanol (CH <sub>3</sub> CH <sub>2</sub> OH), 70% V/V         | Alcohol         |
| 4. Sodium hypochlorite (NaOCl), 5% di chlore (Cl <sub>2</sub> ) | Bleaching       |
| 5. Methylene Blue, 1% m/m                                       | Staining agents |
| 6. Sodium chloride (NaCl), 170g/l, diluted at 50%               | Salt            |

Testing of resistance to house cleaning products:

| DETERGENTS       |
|------------------|
| Lysoform         |
| Viakal           |
| Cif Cream        |
| Bleach           |
| Ammonia          |
| Alcool           |
| Multiuse Cleaner |

Results of resistance tests on chemicals and coloring agents:

|                   |                                             | <i>Evaluation and conformity</i>  |                                               |                                                      |
|-------------------|---------------------------------------------|-----------------------------------|-----------------------------------------------|------------------------------------------------------|
| <i>Family</i>     | <i>Product</i>                              | <i>After rinse<br/>with water</i> | <i>Water<br/>cleaning<br/>with<br/>sponge</i> | <i>Allumina +<br/>wáter cleaning<br/>with sponge</i> |
| <b>1 - Acids</b>  | Acetic Acid (CH <sub>3</sub> COOH), 10% V/V | <b>E</b>                          | <b>E</b>                                      | <b>/</b>                                             |
| <b>2 - Alkali</b> | Soda caustic (NaOH), 5% m/m                 | <b>E</b>                          | <b>E</b>                                      | <b>/</b>                                             |

|                      |                                                                               |          |          |          |
|----------------------|-------------------------------------------------------------------------------|----------|----------|----------|
| <b>3 - Alcohol</b>   | Ethanol (C <sub>2</sub> H <sub>5</sub> OH), 70% V/V                           | <b>E</b> | <b>E</b> | <b>/</b> |
| <b>4 - Bleach</b>    | Sodium Hypochlorite (NaOCl), 5% active chlore (Cl <sub>2</sub> ) <sup>1</sup> | <b>E</b> | <b>E</b> | <b>/</b> |
| <b>5 - Colourant</b> | Methylene blue, 1% m/m                                                        | <b>E</b> | <b>E</b> | <b>/</b> |
| <b>6 - Salts</b>     | Sodium chloride (NaCl) 170g/l, diluted to 50%                                 | <b>E</b> | <b>E</b> | <b>/</b> |

Results of resistance tests of surfaces to domestic cleaning products:

| <b>Product</b>           | <b>Evaluation and conformity</b> |                                   |
|--------------------------|----------------------------------|-----------------------------------|
|                          | <b>After rinse with water</b>    | <b>Water cleaning with sponge</b> |
| 1. Lisoform Bathroom Gel | <b>E</b>                         | <b>E</b>                          |
| 2. Viakal                | <b>E</b>                         | <b>E</b>                          |
| 3. Cif creme             | <b>E</b>                         | <b>E</b>                          |
| 4. Bleach                | <b>E</b>                         | <b>E</b>                          |
| 5. Ammonia               | <b>E</b>                         | <b>E</b>                          |
| 6. Alcool                | <b>E</b>                         | <b>E</b>                          |
| 7. Multiuse (Glassex)    | <b>E</b>                         | <b>E</b>                          |

Legend of evaluation codes:

| <b>CODE</b> | <b>SIGNIFICANCE</b>                                                             |
|-------------|---------------------------------------------------------------------------------|
| A           | Surface deformation (NC)                                                        |
| B           | Evident change of colour and brilliance (NC)                                    |
| C           | Moderate change of colour and brilliance rillantezza (NC)                       |
| D           | Light change of colour and brilliance, visibile only at certain viewsights (NC) |
| E           | No visible change (C)                                                           |

Results are positive and the growing interest in a high-performance, recycled coating is considered beneficial in many applications.

## 5.5 External test reports: resistance to wet heat



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|                                                                                                                                                     |                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>TEST REPORT</b><br><br><b>391056 / 1</b><br>Revision: 0<br>Date of sample receipt: 29/01/25<br>Date of test: 22/02/25<br>Date of issue: 24/02/25 | <b>GEES RECYCLING S.R.L.</b><br><b>VIA MONTE COLOMBERA 22</b><br><b>33081 AVIANO (PN)</b><br><b>ITALIA</b> |
| Sample name: Pannello Life Green Composite Type 2 Coated                                                                                            |                                                                                                            |

### Surface resistance to wet heat UNI EN 12721:2013

Test results:

| Temperature °C                   | Rating | Remarks             |
|----------------------------------|--------|---------------------|
| 55                               | 5      | No visible changes. |
| 70                               | 5      | No visible changes. |
| 85                               | 5      | No visible changes. |
| 100                              | 5      | No visible changes. |
| Reached class CEN/TS 16209:2022* |        | A+                  |

\* Classification not covered by accreditation.

Note:

- chemical analysis of the tested material has not been carried out;- the temperatures are according to CEN/TS 16209:2022 standard.
- Conditioning period: from 29/01/2025 to 22/02/2025.

This test report is part of a PDF file digitally signed by Franco Bulian.

The managing director  
Dr. Franco Bulian

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## 5.6 External test report: effects of light exposure



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LAB N° 0027 L  
Membro degli MRA EA, IAF e ILAC

|                                                                                                                                                                                                                                            |                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| <p><b>TEST REPORT</b></p> <p><b>391056 / 2</b></p> <p>Revision: 0</p> <p>Date of sample receipt: 29/01/25</p> <p>Date of test: 22/02/25</p> <p>Date of issue: 24/02/25</p> <p>Sample name: Pannello Life Green Composite Type 2 coated</p> | <p>GEES RECYCLING S.R.L.</p> <p>VIA MONTE COLOMBERA 22</p> <p>33081 AVIANO (PN)</p> <p>ITALIA</p> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|

### Effects of light exposure UNI EN 15187:2007

|                                                                                                                     |                       |
|---------------------------------------------------------------------------------------------------------------------|-----------------------|
| Apparatus:                                                                                                          | Atlas C.i. 3000+ w.o. |
| Radiation source:                                                                                                   | Xenon arc lamp        |
| Irradiance at 420 nm:                                                                                               | 1,25 W/m <sup>2</sup> |
| Inner filter:                                                                                                       | borosilicate          |
| Outer filter:                                                                                                       | soda-lime             |
| Black panel temperature:                                                                                            | 55 ± 2 °C             |
| Irradiance determination system:                                                                                    | automatic             |
| Relative humidity:                                                                                                  | 50 ± 10%              |
| Blue wool standard assessment:                                                                                      | visual                |
| N. of observers:                                                                                                    | 2                     |
| Test duration: until grade 4 color change of the blue wool standard n. 6 in the grey scale                          |                       |
| Test results:                                                                                                       |                       |
| Grey scale<br>ISO 105 A02                                                                                           | Remarks               |
| <b>4/5</b>                                                                                                          | ///                   |
| Light fastness:                                                                                                     |                       |
| Grey scale                                                                                                          | Blue wool standard n. |
| <b>&gt; 4</b>                                                                                                       | <b>&gt; 6</b>         |
| Notes:                                                                                                              |                       |
| - Chemical analysis of the tested material was not carried out.                                                     |                       |
| - Conditioning period: from 29/12/2023 to 26/01/2024.                                                               |                       |
| - The evaluation of the sample was performed by comparing the part exposed to the light against the reference part. |                       |

page 1/1

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The managing director  
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## 5.7 Photographic impressions of panels and tests

The photo report includes pictures of Type 2 panels produced by the production tests 201.14, 202.18 and 204.19 (pictures 1 to 4) and of the flame test performed on the panel produced in test 204.19 (pictures 5).

Test 201.14



*Picture 1: Type 2 201.14 Lot #105*

Here a 4 mm coating on a 20 mm Type 2 panel Lot 105  
This does not modify the recycling of the material.

Test 201.14



*Picture 2: Test 201.14 # Lot # 105*

Evaluation: Good consistency and compactness for 201.14 . Good R-PMMA Surface with some bumps

Test 202.18



*Picture 3: Test 202.18 lot #211*

Evaluation: Good consistency , not satisfactory R-PMMA Surface

Test 204.19





*Picture 4: Test 204.19 lot # 298*

Evaluation: Very Good compactness , really nice aspect with coarse shredded sink waste and fiberglass – Good R-PMMA Surface

Recipe definite. Density 1.05 of R-PMMA coating

This recipe will ensure a good impermeability and hydrophobicity on all the mass of material.

Flame behaviour tests of Type 2 – 204.19 following EN 13501 FL



*Picture 5: Flame behaviour tests following EN 13501 FL*

Evaluation:

Very Good .

Back of panel totally intact, loss of weight below 2,5%.

### **5.8 Report on CNC Cutting cutting and milling of the Type 2 Panels**

Each panel made was refiled on the production line and calibrated using a double-sanding line.

We have also verified the feasibility of milling on our CMS PENTAX CNC 5-axes machining centre





*Picture 6: CNC milling of Type 2 panel*



*Picture 7: CNC milling of Type 2 panel coated*

Note different color of milled surface

Milling was feasible and not different from our other recycled composites materials, no issue from the CNC milling also through the R-PMMA coating , with no deflaking or other defects, although since the milling removes the coating, for maximal protection it should be reapplied.



Here below a table of the processing:

| Type 2 anel application      | Coating              | Solution                                     |
|------------------------------|----------------------|----------------------------------------------|
| Milling - 3D surface         | Need to be reapplied | Coating on finished product                  |
| Drilling and through cutting | Coating good on face | Coating of side and flanks only for hard use |

## 6. Green worktops Type 3

### 6.1 Composition

TYPE 3 panels are solid colour panel Multilayer: Composed of a visible layer (10 to 20%) and an invisible layer (90 to 80%). The invisible layer consists of 95% various lightened polyester scraps, glass fibre and PVC; 5% polyurethane resin Resulting in a Lower quality slab with low density. Outer surface in sink waste composite/dispersion green, in specific R-PMMA and R-Granulates or R-Quartz and inner core in recycled low-density rigid foam, to be placed on market that is currently dominated by wood-particle laminates; the goal is to produce a panel with a recycled material content of at least 95%.

|                                          |                 |                                                                    |
|------------------------------------------|-----------------|--------------------------------------------------------------------|
| SOLID COLOR PANEL<br>MULTILAYER (TYPE 3) | 50              | DELTA sink waste                                                   |
|                                          | 20 to 35%       | Polyester and rigid foams                                          |
|                                          | 5%<br>10 to 25% | Polyurethane resin<br>R-PMMA Coating with r-granulates or r-quartz |

### 6.2 Production trials and evaluation

GEES conducted 5 different test runs , on production and laboratory press.

We have tried both the co-moulding of the visible outer layer R-PMMA+R-Granulates over the Medium density recycled composites (tests 256/02 and 268/02) , and the lamination of previously made R-PMMA+R-Granulates over Medium density recycled composites (tests 255/01 and 265.01).

The co-moulding tests yielded unacceptable results, with an un-evenness of the surface - characteristic that was sought - but with erratic and non-replicable results, probably due to the different polymerisation behaviours of the different resins and the difficulty of obtaining a constant heating of the resin-filler mixture.

Below is the summary table of tests conducted and results obtained from the first standard evaluation based on density, flatness and surface characteristics.

**Life Green      Production tests**  
**Composite      Type 3**

| Test # | Period | Lot #      | Thickness | Density avg | Density Max | Density min | In tolerance | Planarity | Surface  | Edge |
|--------|--------|------------|-----------|-------------|-------------|-------------|--------------|-----------|----------|------|
| 255/01 | May 24 | A15        | 20+5      | 1055        | 1112        | 1010        | Yes          | <3        | Good     | Good |
| 256/02 | Jul 24 | A15+Plados | 20+7      | 1241        | 1250        | 1155        | No           | >5        | Bad      | Bad  |
| 265/01 | Sep 04 | 298        | 24+3      | 1055        | 1080        | 1001        | Yes          | >3        | Discrete | Bad  |
| 268/02 | Sep 24 | 299        | 24+4      | 1045        | 1100        | 1002        | No           | >5        | Bad      | Bad  |

### 6.3 External test report: mechanical performances

The impossibility to have a repeatable performance led to the avoidance of mechanical tests on the Type 3 panels, since the variability of results would have made them unusable.

### 6.4 External test reports: resistance to stains, chemicals and cleansing products

For this panel type 255/01 were done again tests to stain and chemical resistance to confirm the good results obtained with the coated monolayer, to be sure of the potential of compact recycled "Solid Surface style" for future application in separated production.

Here are some excerpts from tests results from DELTA.

**DELTA TECHNICAL REPORT      D-01/2025**

Test on resistance to chemical products

|                      |                                             | <b><i>Evaluation and conformity</i></b> |                                          |                                                     |
|----------------------|---------------------------------------------|-----------------------------------------|------------------------------------------|-----------------------------------------------------|
| <b><i>Family</i></b> | <b><i>Product</i></b>                       | <b><i>After rinse with water</i></b>    | <b><i>Water cleaning with sponge</i></b> | <b><i>Allumina + water cleaning with sponge</i></b> |
| <b><i>Acids</i></b>  | Acetic Acid (CH <sub>3</sub> COOH), 10% V/V | <b>E</b>                                | <b>E</b>                                 | <b>/</b>                                            |
| <b><i>Alkali</i></b> | Soda caustic (NaOH), 5% m/m                 | <b>E</b>                                | <b>E</b>                                 | <b>/</b>                                            |

|                   |                                                                               |          |          |          |
|-------------------|-------------------------------------------------------------------------------|----------|----------|----------|
| <b>Alcol</b>      | Ethanol (C <sub>2</sub> H <sub>5</sub> OH), 70% V/V                           | <b>E</b> | <b>E</b> | <b>/</b> |
| <b>Whithening</b> | Sodium Hypochlorite (NaOCl), 5% active chlore (Cl <sub>2</sub> ) <sup>2</sup> | <b>E</b> | <b>E</b> | <b>/</b> |
| <b>Colorants</b>  | Methylene blue, 1% m/m                                                        | <b>E</b> | <b>E</b> | <b>/</b> |
| <b>Salts</b>      | Sodium chlorure (NaCl) 170g/l, diluite to 50%                                 | <b>E</b> | <b>E</b> | <b>/</b> |

### Test on surfaces resistance to domestic cleaning products

| <b>Product</b>           | <b><i>Evaluation and conformity</i></b> |                                          |
|--------------------------|-----------------------------------------|------------------------------------------|
|                          | <b><i>After rinse with water</i></b>    | <b><i>Water cleaning with sponge</i></b> |
| 1. Lisoform Bathroom Gel | <b>E</b>                                | <b>E</b>                                 |
| 2. Viakal                | <b>E</b>                                | <b>E</b>                                 |
| 3. Cif creme             | <b>E</b>                                | <b>E</b>                                 |
| 4. Bleach                | <b>E</b>                                | <b>E</b>                                 |
| 5. Ammonia               | <b>E</b>                                | <b>E</b>                                 |
| 6. Alcool                | <b>E</b>                                | <b>E</b>                                 |
| 7. Multiuse (Glassex)    | <b>E</b>                                | <b>E</b>                                 |

### Legenda of evaluation results

- A.** Deformation or swelling of surface (NC)
- B.** Evident change of color and gloss (NC)
- C.** Moderate change of color and gloss (NC)
- D.** Very light change of color and gloss, visible only on particular viewing angle (NC)
- E.** No visible changes (C)

Results are confirming the high resistance of R-PMMA-R-Granulates-R-Quartz compact material; in future we will evaluate new production technologies.

## 6.5 Photographic impressions of panels and tests

The photo report includes pictures of Type 3 panels produced by the production tests 255.01, 256.02, 265.01 and 268.02 (pictures 8 to 11)

Test 255.01



*Picture 8: Type 3 panel 255.1*

Evaluation: Very good product , good alternative to virgin Solid Surface . The impossibility of a direct production with co-moulding (verified in later tests) makes this much more complex and require a different production line specific for solid surface

Test 256.02





*Picture 9: Type 3 panel 256.02*

**Evaluation:**

This co-moulding test shows the erratic behaviour of the R-PMMA resin with the R-Granulates outer layer , the result varies too much to be reliable for industrial production , plus the different resins induce tensions on the panels that may become convex or concave

Test 265.01



*Picture 10: Type 3 panel 265.01*

**Evaluation:**

Test of lamination of moulded R-PMMA+R-Granulates are much more constant and repeatable , however care need to be used with a good surface finish of both layers, to avoid fissures or pause of contact between the two layers.

Test 268.02



Picture 11: Type 3 panel 268.02

#### Evaluation:

One of the many tests made to try the comoulding without good results - As shown the variability may be also due to the R-PMMA polymerisation behaviour at the higher temperature required by the GEES process for medium density composite process; in this case the R-PMMA+R-Granulate layer seems to have microbubbles from resin boiling.

## 7. Type 4 Panels

The results of the Type 3 panels were not satisfactory especially for the simpler co-moulding process; this led us to choose to develop an additional type of panel that would ensure:

- Uniform and homogeneous composition
- Possibility of mass-tooling like milling
- Lower wear and energy use

### 7.1 Composition and production trials

Learning from the experiences of Type 1 and 3 we chose to have a better selection of the raw feedstock, using a sieved white sink waste of granulometry 0,3-2,5 mm mixed with a low density < 2 mm powder from Rohacell PMI foam recycling, that act both as a fluidifying agent and compatibilizer (PMI foam is both of acrylic origin). In this way we obtained:



- Type 4 Solid colour panel Monolayer: composed of 70 % White sink waste and 30% White PMI Rohacell powder <2 mm , Additivated with 5% of black iron oxide.

The addition of black iron oxide allowed us to verify whether the granulated waste of the White sink, which is the largest quantity, can allow us to obtain a colored mass material with a homogeneous structure and appearance.

- Two tests were done, for medium density <840 kg /m3 and high density 1400 kg/m3

Life Green Composite    Production tests Type 4

| Test # | Period | Lot #   | Thickness | Density avg | Density Max | Density min | In tolerance | Planarity | Surface | Edge |
|--------|--------|---------|-----------|-------------|-------------|-------------|--------------|-----------|---------|------|
| 302/1  | Jan 25 | 10      | 20        | 845         | 910         | 812         | Yes          | <3        | Good    | Good |
| 303/2  | Feb 25 | 17. 644 | Multiple  | 1400        | 1420        | 1381        | Yes          | <3        | Good    | Good |

The sink waste prepared for the test:



*Picture 12: sink waste mixed with PMI foam*

Feedstock mixed before adding bonding agent

- Feedstock doesn't create problems in mixing and homogenizing, seems to have a lower wear on tools and parts - probably due to PMI powder acting as a fluidizing agent
- Production requires high pressure to ensure the surface quality
- Cycle time is analogue to other sink waste based materials

This material was also coated with R-PMMA resin obtaining the same results of resistance to chemical products and stains as for the other panel Types.,



*Picture 13: Panel on production line*

Test 303/2 lot # 17644 was made for the industrial production of High density Type 4 panels in the following thickness: 25 mm, 22 mm, 15 mm, 12 mm.

Density 1400 kg/m<sup>3</sup> was indicated by potential customers as the ideal for natural stone alternative.

### **External test reports: chemical resistance**

### **7.2 External test report: mechanical performance**

Test 303/2 lot # 17644 material was subject to Flexion and Compression tests, that show an increase in resistance and reduction of variability. This is probably due to the better homogenization, reduction of very small fines, thus increasing the efficacy of the bonding agent.

A note on tests results : the Thickness of the panels was 22 mm for the uncalibrated panel, reduced to 21 mm after calibration , variations on thickness are intrinsic to the process and recycled content.





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## TEST REPORT

398231 / 1

Revision: 0  
Date of sample receipt: 20/04/25  
Date of test: 12/05/25  
Date of issue: 21/05/25

Sample name: Pannello Life Green Composite type 4

GEES RECYCLING S.R.L.  
VIA MONTE COLOMBERA 22  
33081 AVIANO (PN)  
ITALIA

### Plastics - Flexural properties UNI EN ISO 178:2019

Sample description: Not declared  
Test method: A (one speed of testing)  
Nominal thickness: 22 mm  
Support span: 336 mm  
Specimen preparation: Performed by the customer  
Test direction: Not identifiable Specimen shape: Parallelepiped  
Conditioning: > 72 h (23±2 °C and 50±5% r.h.) Testing temperature: 20±5°C  
Testing equipment: Instron dynamometer mod. 5585 Test speed: 5 mm/min  
Tested surface: Not identifiable

#### Risultati della prova:

| Specimen n°        | Width mm | Thickness mm | Maximum load N | Flexural strength MPa | Modulus of elasticity MPa |
|--------------------|----------|--------------|----------------|-----------------------|---------------------------|
| 1                  | 19,7     | 21,33        | 185            | 10,2                  | 3.890                     |
| 2                  | 19,2     | 21,04        | 191            | 12,5                  | 4.264                     |
| 3                  | 19,8     | 21,33        | 225            | 13,4                  | 4.545                     |
| 4                  | 20,3     | 21,04        | 156            | 9,2                   | 3.245                     |
| 5                  | 19,1     | 21,34        | 182            | 11,3                  | 3.985                     |
| 6                  | 20,4     | 21,34        | 212            | 11,3                  | 3.985                     |
| 7                  | 19,6     | 21,04        | 165            | 9,5                   | 3.489                     |
| Mean Value         |          |              |                | 11,1                  | 3.914                     |
| Standard deviation |          |              |                | 1,4                   | 251                       |

#### Notes:

- Test ref. declared by the customer: Progetto 101074703-LIFE21-ENV-IT LIFE GREEN COMPOSITE
- Chemical analysis of the tested material has not been carried out.
- The company who asked for the test has collected and sampled the specimens.

*low use*

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Testing Certification Research

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# TEST REPORT

## 398231 / 2

Revision: 0  
Date of sample receipt: 20/04/25  
Date of test: 12/05/25  
Date of issue: 21/05/25

Sample name: Pannello Life Green Composite type 4

GEES RECYCLING S.R.L.  
VIA MONTE COLOMBERA 22  
33081 AVIANO (PN)  
ITALIA

## Plastics - Compressive strength UNI EN ISO 604:2008

Sample description declared: Not declared  
Specimen shape and load direction: Parallelepiped and a compressive load is applied on the specimen surface  
Nominal thickness: 22 mm  
Conditioning: > 72h (23±2 °C and 50±5 % r.h.) Test conditions 23±2°C and 50±5 % r.h.  
Test equipment: Instron dynamometer mod. 5985  
Load applicators: Steel plates (Ø 150 mm)  
Test speed: 2 mm/min

### Test results:

| Specimen n°        | Width mm | Length mm | Maximum load N | Compressive strength MPa |
|--------------------|----------|-----------|----------------|--------------------------|
| 1                  | 20,26    | 19,98     | 13.520         | 34,2                     |
| 2                  | 20,44    | 20,04     | 15.450         | 37,9                     |
| 3                  | 20,41    | 20,43     | 15.402         | 37,4                     |
| 4                  | 19,92    | 20,11     | 14.680         | 36,9                     |
| 5                  | 20,52    | 19,78     | 15.954         | 38,6                     |
| 6                  | 20,32    | 20,12     | 13.850         | 34,6                     |
| 7                  | 19,30    | 19,91     | 13.803         | 34,6                     |
| 8                  | 20,49    | 19,32     | 15.074         | 37,8                     |
| Mean value         |          |           |                | 36,5                     |
| Standard deviation |          |           |                | 1,9                      |
| Coeff. of var.     |          |           |                | 5,2 %                    |

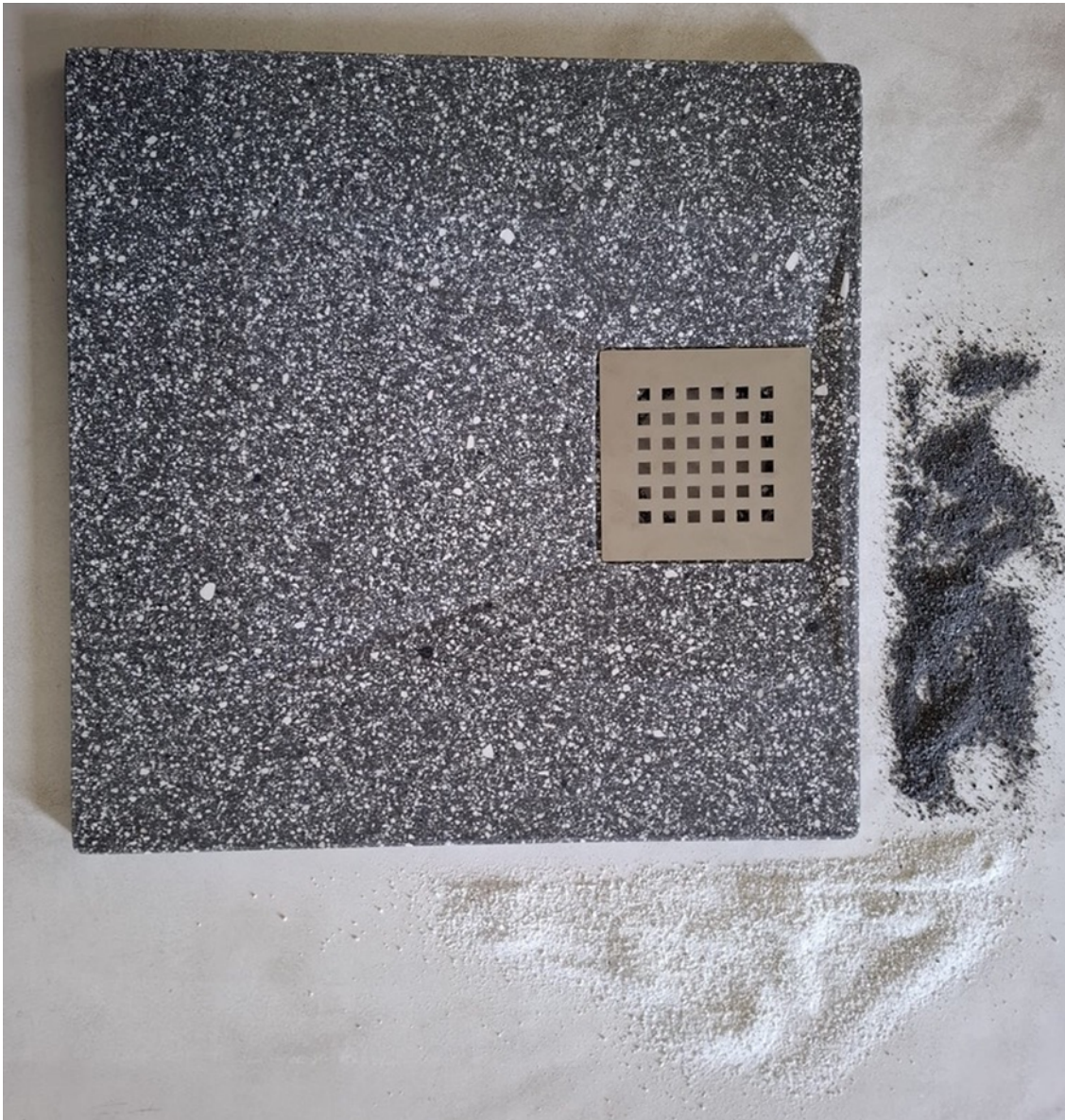
### Notes:

- Test ref. declared by the customer: Progetto 101074703-LIFE21-ENV-IT LIFE GREEN COMPOSITE- Chemical analysis of the tested material has not been carried out.
- The company who asked for the test has collected and sampled the specimens.



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### 7.3 Photographic impressions of panels Type 4



*Picture 14: Showertray made with Test 303/2 lot # 17644 - Material with the feedstocks in evidence*

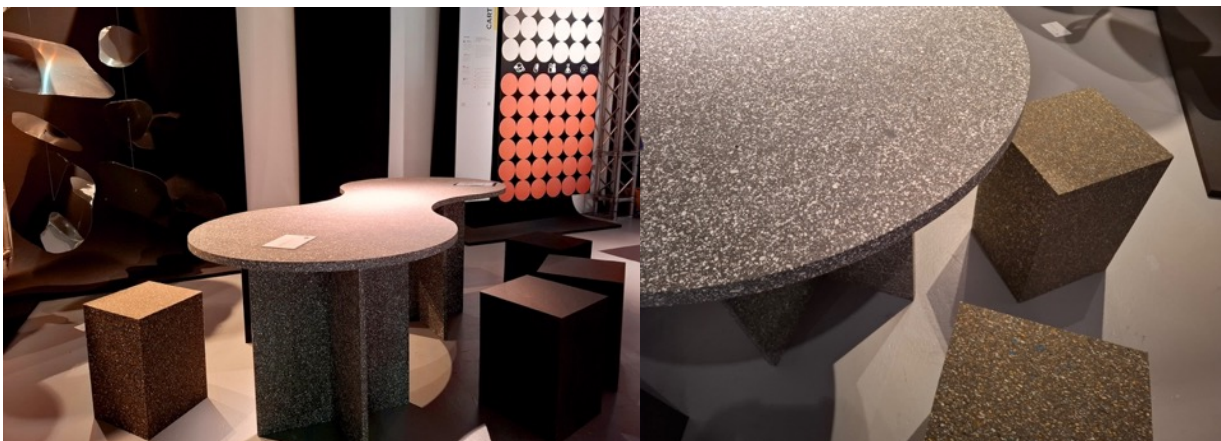
Evaluation: Test had very good results





*Picture 15: samples prepared for the commercial launch*

Aesthetic results were so good to put in the catalog and sample collection , for presentation to Salone del Mobile in Milan, where several applications of Type 4 were exposed.



*Picture 16: Materially exposition of Type 4 materials at Milan Salone del Mobile*



## 8. Conclusions

Experiments and production trials demonstrated that the production of kitchentops from recycling of kitchen sinks and other composite waste is feasible and achievable in the same production line of lower density recycled composites.

3 different types of panels are all obtainable with standard production techniques and small modifications to recipes. The type 3 panels could not be obtained with a single co-moulding process and requires two specific processes, thus making the production more complex and increasing the costs and impacts; still this may be an alternative to virgin solid surfaces materials with high costs and high impacts.

To summarize the results obtained in panels development:

Type 1 – Ex. **READY FOR MARKET APPLICATION** Development details in Deliverable 3.1.

Type 2 - Recycled Sink waste panel with R-PMMA Coating / surface layer

Type 3 - Recycled medium density panel with surface layer in R-PMMA and R-Granulates or R-Quartz

Type 4 - Recycled Sink waste and PMI Foam powder

Type 1, 2, and 4 may be made with a single step process, while Type 3 needs two specific different moulding and a lamination to have a standardized constant product; the complete process has not been completed.

Found the right recipe of process, and having done modifications, material obtained is solid, compact, naturally hydrophobic , thus confirming to reach the properties required for a mass market application. Capable to be milled and cutted on CNC machines or standard with specific diamond or carbide tooling.

Production showed that doesn't require more energy respect other kind of waste feedstock , so the LCA if the new material will be probably as favorable as the other standard Gees products.

One of the most significant results of this Project is the development of the R-PMMA Coating "R-Syrup" that is a real breakthrough : Currently there are no commercial coatings of any type with a significant recycled content apart powder coating, where Arkema has announced as environmental innovation powdercoatings with up to 40% recycled content; DELTA R-Syrup has more than 90% recycled content and a really favourable environmental balance.

The combination of recycled product with recycled coating is a relevant innovation , totally in line with project .