NEW GENERATION OF RECYCLED HYBRID PRODUCTS

Made of post-consumer recycled composites

Because everything starts with a new life

HYBRID COMPONENT MEETING

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Managing director of TECOS, Slovenian Tool & Die Development Centre
We are the members of LIFE CEPLAFIB!

European Consortium of 6 partners from 4 EU Member States: Slovenia, Spain, Poland and Finland

Our project started in July 2018 and will be finished by the end of 2021

It is worth €1,832,020 in total, of which 60% is attributed by the European Union

LIFE17 ENV/SI/000119, with the contribution of the LIFE Programme of the European Union
TODAY’s TOPICS

Facts & Numbers
Aims & Targets
Recycled Hybrid Materials
Key benefits of CE solutions
LCC & LCA Footprint
Disturbing Facts About Plastics

PLASTIC PRODUCTION DATA
In 2018 global plastics production almost reached 360 million tons. In Europe, plastics production almost reached 62 million tons.

MANUFACTURING IS EXPENSIVE
Over the past five years, the price of plastic has swung from €950/MT (metric ton) to highs of more than €1500/MT.

450 YEARS NEEDED TO DEGRADE
- Meanwhile, more than 150 million tons of plastic waste float on ocean's surface
- 500 billion plastic bags are used each year
- 1 million plastic bottles are bought every minute
- 13 million tons of plastic leaks into the ocean each year
- 100,000 marine animals are killed by plastic waste.
In 2018, 29.1 million tons of plastic waste were collected in the EU28+NO/CH in order to be treated.

Plastic waste exports outside the EU have decreased by 39% from 2016 to 2018.
Amount of Paper Waste Accumulated

Statistics from 2018-2020

As we speak, more than 199 tons of paper has already been produced. 324 liters of water is used to make 1 kilogram of paper. To print a Sunday edition of the New York Times requires 75,000 trees. Recycling 1 ton of paper saves around 682.5 gallons of oil, 26,500 liters of water and 17 trees.

The global paper recycling rate stands at about 58%.

Paper recycling in Europe reaches 72.3%.

Paper accounts for 25% of waste in the landfill and 33% of municipal waste.
WE CLAIM THAT RECYCLING RATES OF POST-CONSUMER PLASTICS & PAPER WASTE CAN BE INCREASED BY 40%.

WE STRIVE TO REDUCE THE GREENHOUSE GAS EMISSIONS BY THE SAME PERCENTAGE RATE!
We are implementing a new circular economy with all-recycled materials, that are recovered from post-consumer plastic waste and rejected newsprint paper.

The resulted composites, thanks to the reinforcing effect of newsprint fibres, exhibits an outstanding improvements in mechanical properties.

With up to 210% improved modulus of elasticity and up to 40% higher strength, these materials can now compete or even displace the use of virgin plastic.

**UP-CYCLING THE PLASTIC MATRICES**

Sorting, washing, extruding and testing of recycled plastic granules.

**RECLAIMING THE NEWSPRINT FIBRES**

Sorting, modifying and drying of new reinforcing fillers.

**NEW COMPOSITES COMPOUNDING**

Combining of recycled plastic and fibres via extrusion compounding.
CEPLAFIB HYBRID MATERIAL FORMULATIONS

Optimisation of hybrid material formulations by correct selection of high quality recycled plastic matrices, proper proportion of newsprint fibres, coupling agents and impact modifiers.

Ceplafib® rPP/NP for Injection Moulding Applications
- Recycled PP matrix
- Up to 30% of Newsprint Fibres
- Coupling Agents & Impact Modifiers

Ceplafib® rPE (LD/HD)/NP for Thermofoming Applications
- Recycled PE matrix of mixed HD/LD ratio
- Up to 15% of Newsprint Fibres
- Coupling Agents & Impact Modifiers
Ceplafib rPP/NP

- Composite granulate suitable for plastic processing technology by injection molding
- Contains 30% by weight of newsprint fibers
- The base material is recycled polypropylene
- Demonstrates 195% improved modulus of elasticity compared to recycled polypropylene (rPP) 40% higher strength than recycled polypropylene matrix
- The addition of fibers acts as a nucleating agent to increase the crystallinity of composite materials

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<tr>
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<th>$X_{C_{HDPE}}$ (%)</th>
<th>$X_{C_{PP}}$ (%)</th>
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<tbody>
<tr>
<td>rPP</td>
<td>5.5 %</td>
<td>20.4 %</td>
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<tr>
<td>rPP/NP</td>
<td>6.2 %</td>
<td>21.8 %</td>
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Modulus of Elasticity (MPa)

Tensile Strength [MPa]
Comparison of Selling Prices

**CEPLAFIB and competing PP materials for injection moulding applications**

<table>
<thead>
<tr>
<th>Material</th>
<th>Selling Price [€/ton]</th>
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<tbody>
<tr>
<td>Wood plastic composites (vPP/WF)</td>
<td>2240 €/ton</td>
</tr>
<tr>
<td>Wood plastic composites (rPP/WF)</td>
<td>1890 €/ton</td>
</tr>
<tr>
<td>Virgin polypropylene (vPP)</td>
<td>1412 €/ton</td>
</tr>
<tr>
<td>CEPLAFIB® rPP/NP</td>
<td>917 €/ton</td>
</tr>
<tr>
<td>CEPLAFIB rPP</td>
<td>680 €/ton</td>
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</tbody>
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Ceplafib rPE(LD/HD)/NP

- Available in granulate or thermoforming sheets
- It contains 20% by weight of newsprint fibers
- The base material is recycled polyethylene mixed LD/HD ratio
- Demonstrates 222% improved modulus of elasticity compared to recycled polyethylene base (rPE LD/HD)
- 14% higher strength than recycled polyethylene matrix
- The addition of fibers acts as a nucleating agent to increase the crystallinity of composite materials

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<th>CRYSTALLINITY DEGREE</th>
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<tbody>
<tr>
<td></td>
<td>$X_{rPE(LD/HD)}$ (%)</td>
</tr>
<tr>
<td>rPE</td>
<td>30.5 %</td>
</tr>
<tr>
<td>rPE/NP</td>
<td>44.2 %</td>
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![Graph showing Modulus of Elasticity and Tensile Strength comparisons](image-url)
Comparison of Selling Prices

<table>
<thead>
<tr>
<th>Material</th>
<th>Selling Price Per Unit</th>
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<tbody>
<tr>
<td>Wood bioplastic composites (bioPF/WF)</td>
<td>3820 €/ton</td>
</tr>
<tr>
<td>Wood plastic composites (PE/CF)</td>
<td>1700 €/ton</td>
</tr>
<tr>
<td>Virgin polyethylene (PE)</td>
<td>1334 €/ton</td>
</tr>
<tr>
<td>CEPLAFIB Composite Pellets (rPE/NP 15)</td>
<td>989 €/ton</td>
</tr>
<tr>
<td>CEPLAFIB recycled polyethylene (rPE)</td>
<td>610 €/ton</td>
</tr>
</tbody>
</table>

CEPLAFIB and competing PE materials for thermoforming applications
With validated hybrid material composition based on recycled PE and 15 wt.% of newsprint paper fibres we are now able to produce protective thermoformed covers for concrete or PVC pipes and stable containers for protecting sensitive instruments/devices during the logistic transportation.
AUTOMOTIVE PARTS
MADE OF RECYCLED
HYBRID COMPOSITES

We have developed specific technical material grades with excellent impact and formable properties. These are now used for injected construction parts and thermoformed protection panels installed in ADRIA Mobil’s Motorhomes.

Double floor concept for hidden electrical installations
CEPLAFIB distance holders for lifting the double floor
CEPLAFIB protection panels for covering the venting lines
With tailored composite grades we are opening new market opportunities in building/construction sector. With standardized procedures we tend to prove that CEPLAFIB materials are easily transferable for interior & exterior applications.

**CONSTRUCTION**

**CEPLAFIB MATERIALS IN CONSTRUCTION SECTOR**

Decorative facade panels made of recycled waste plastic & paper

Acoustic barrier panels with excellent insulation characteristics

CEPLAFIB testing cubes for concrete samples
Comparative LCA for thermoformed products made of virgin HDPE, recycled PE & hybrid CEPLAFIB composites

Comparative LCA for injection moulded products made of virgin ABS & PP, recycled PP & hybrid CEPLAFIB composites
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