

Recycled aggregates in the prefabrication sector

Riccardo Angiuli Ph.D.



1994

CETMA

Research and Technology Organization (RTO)

Our Numbers

Applied research, experimental development and technology transfer in the field of **advanced materials, ICT and product development.**

112 Research projects

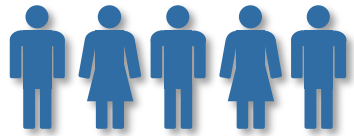
31 European research projects

1300 Service contracts

20 Advanced education projects

Research and Technology Organization

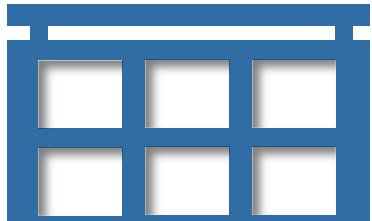
Technical structure



65+ Employees: Researchers, engineers, designer & manager



Offices and laboratories extended for over **3.500** m²



15 Laboratories

1. Virtual Reality Centre
2. 3D printers, prototyping, ergonomics
3. Electronics and robotics
4. Visual Tech Lab
5. Exhibit Design
6. Non-destructive controls
7. Composite ovens
8. Composite lamination
9. Composite welding
10. Smart Materials and Structural Monitoring
11. Building materials
12. Molding of polymers and composites
13. Physical thermal analysis
14. Chemical Analysis
15. Mechanical characterization

Research Fields of application

MATERIALS ENGINEERING



- Materials and characterization
- Technologies and processes
- Modelling and simulation
- Diagnostics and civil engineering

COMPUTER ENGINEERING



- Information systems and Knowledge Management
- Automation and control
- Virtual, Augmented reality and Multimedia

DESIGN



- IPR, Design management and Strategic Design
- Concept Design, Engineering and Prototyping
- Ergonomics, UI e UX design

Key expertise in construction materials



R&D on Hot Topics

- Circular Economy & Environment



Construction materials & components

- Buildings & Infrastructures



Structural reinforcing & seismic protection

- Diagnostic



Smart materials & SHM

- Cultural Heritage



Nondestructive diagnostics & assessment

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Area Manager
Riccardo Angiuli PhD
Materials Engineer



Vito Tarantino
Civil Engineer



Agnese Attanasio PhD
Materials Engineer

Alessandra Ramirez
Materials Engineer



- 2 civil engineers
- 3 materials engineers
- 1 architect
- 1 laboratory technician

7 employees

CURRENT SCENARIO

Industrial production, construction, agriculture, daily activities use such a huge amount of material and energy that in the long run it will become unsustainable for our planet

- Enough materials have been produced that can last us for the rest of our time and beyond
- Our cities can be considered **urban mines**
- **CDWs** should be considered an asset (high value)



Why CDW in precasted products?



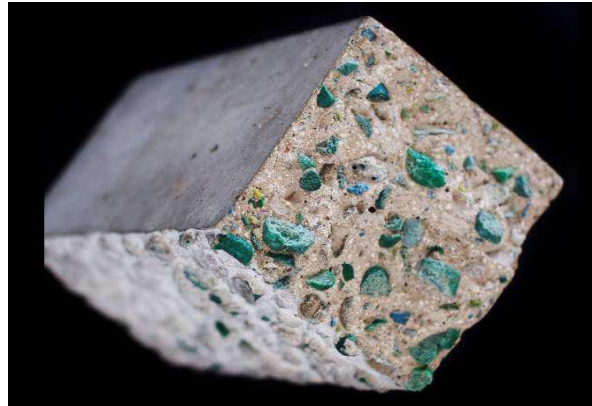
Why CDW in precasted products?

- Massive elements
- Large production volumes
- Non-priority surface finish
- Structural/Non-structural elements



High % of recycled material



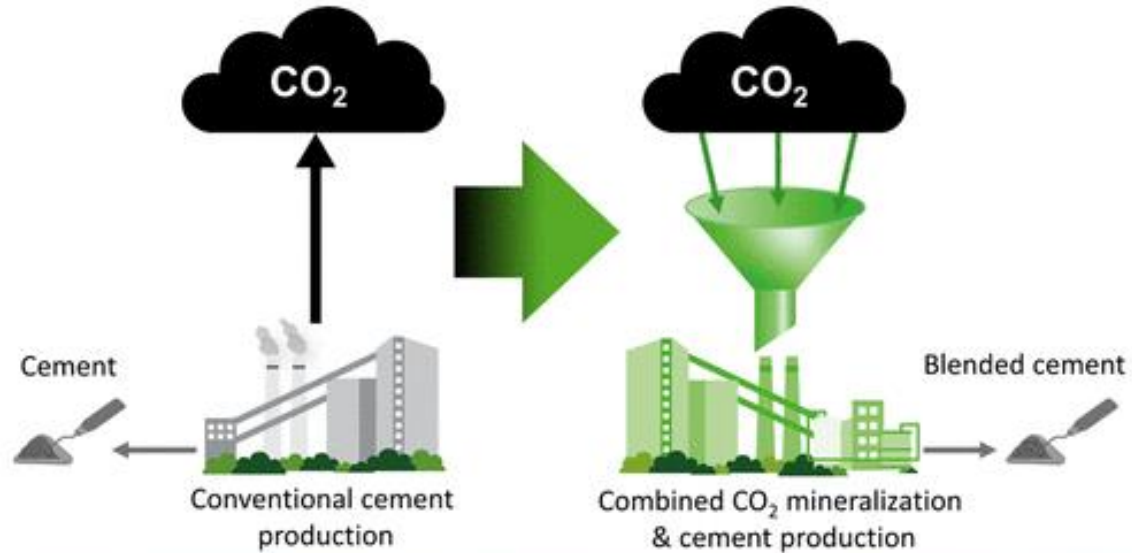


CETMA experience

Materials studied as aggregates

- Mixed plastics
- PUR
- Glass
- Rubber (PFU)
- CDW
- Industrial waste
- Marble and gypsum powder
- Wood
- RAEE

Binder? →



From Unavoidable CO₂ Source to CO₂ Sink?



CETMA experience

Binder

- Low CO₂ cement
- Geopolymers/AAM
- Gypsum



An open innovation test bed for building envelope materials – Pilot line for the development of insulating building solutions with recycled materials

GOAL

Production of insulation materials/components utilizing wastes. Support for characterization and testing activities.

RESULTS

- ✓ Optimization of a LWC fully based on recycled mineral/plastic aggregates
- ✓ Manufacturing of LWC-based construction components incorporating an insulating foam from mineral wastes
- ✓ Innovative insulating blocks installed on an external façade in one demonstration building of the Project (Spain)



FEASIBILITY STUDY ON THE REUSE OF PLASTICS FROM WEEE AS AGGREGATE FOR CEMENT MIXTURES

GOAL

Investigate the potential of recycled WEEE plastics as aggregates for concretes. Testing activities of WEEE plastics-based concretes.

RESULTS

- ✓ Analysis of reference standards
- ✓ Testing of WEEE plastics as aggregate for concretes
- ✓ Development of sustainable concretes based on WEEE plastics aggregates:
 - low plastics content / mechanical performance
 - high plastics content / thermal performance



2021

EDILPRECOMPRESSI - ANMET

Eco-sustainable block integrating recycled GFRP from wind turbine

GOAL

Development of a new eco-sustainable building block integrating GFRP coming from wind turbine blades at the end of life.

RESULTS

- ✓ Analysis and characterization of waste materials
- ✓ Development of formulations based on cement mixture integrating GFRP waste;
- ✓ Physical and mechanical characterization of developed mixtures;
- ✓ Process production development;
- ✓ Process scale up and prototypes production.



— 2023 —
EDILPRECOMPRESSI

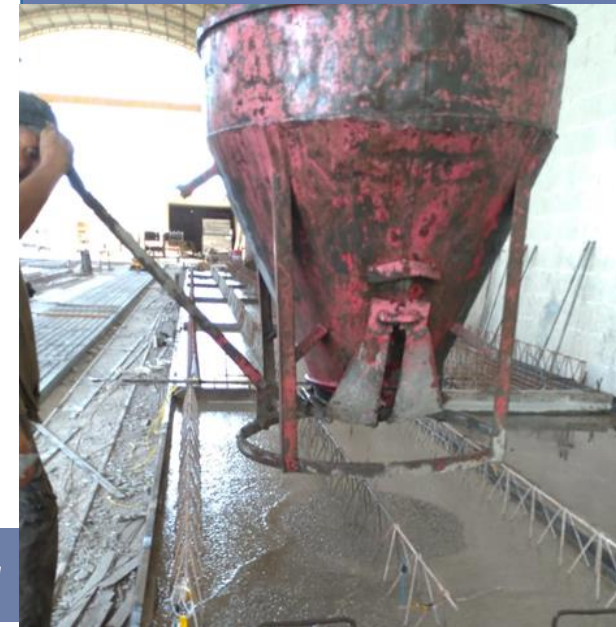
Use of CDW recycled aggregates for the production of sensorized and precasted beam with SHM system

GOAL

Identification of a procedure for grinding, selecting and reusing processing waste from precast concrete

RESULTS

- ✓ Analysis and characterization of production waste;
- ✓ Formulation of cement mixtures that integrate high percentages of recycled aggregates;
- ✓ Physical and mechanical characterization of the developed mixtures;
- ✓ Integration and scale-up in the production process.



— 2023- ongoing —
EXPLOIT4INNOMAT

GOAL

The Exploit4InnoMat OITB (or Ecosystem) aspires to provide a sustainable solution across Europe for the design, upscaling and validation of new material concepts for the building envelope that will facilitate in the achievement of the EC target for nZEB

RESULTS

- ✓ PL 8 upgrade related to geopolymeric matrix integrating waste from rice processing/hemp hurd as aggregate;
- ✓ LCA and LCC on new materials;
- ✓ Physical and mechanical characterization of developed mixtures;



Case study #1 (2019)

GEOCrete [from RE⁴ PROJECT]

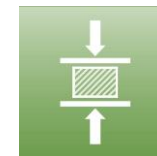


Product

- Eco-sustainable pre-mixed, cement-free concrete made of AAM (PFA/GGBS) and CDW-derived aggregates



2300
kg/m³



42
MPa



3
MPa



-
W/mK



100
%

Case study #2 [2015]

SUS-Block [from SUS-CON PROJECT]

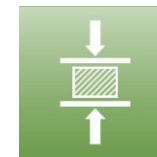


Product

- Cement & virgin materials-free, insulating building blocks based on industrial by-products (e.g. fly ash, slag, perlite tailings) as binders and secondary raw materials (e.g. tyre rubber, PU foam, recycled plastic aggregates) as aggregates



900-1.400
kg/m³



5-20
MPa



1.5/2.25
MPa



0.15-0.25
W/mK



100
%



Case study #3 [2023]

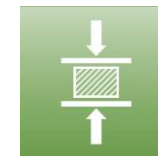
WEEE plastic-based concrete [for GLOBECO customer]

Product

- Reuse of plastic fractions from WEEE as aggregate for sustainable cement mixtures
- Light-weight and normal-weight concretes, depending on the plastic content
- Non-structural concretes



1.780-2.300
kg/m³



18-65
MPa



0,89-1,77
W/mK



Case study #4 [2023]

Insulating block [from ICLIMABUILT project]

Product

- Self-bearing and infill block for insulation uses in buildings
- Sandwich structure – lightweight concrete fully based on recycled aggregates (CDW, plastics) combined with an innovative insulating foam
- Sustainable and Modulable solution



470
kg/m³



3,5
MPa
(concrete)



> 0,23
W/m²K
(thickness 30 cm)

Case study #7 [2012]

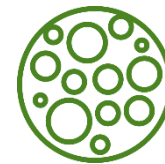
NUMIX [from NUMIX PROJECT]



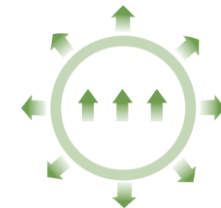
Product

- Lightweight aggregates (flakes and expanded granules) compliant with EN 13055-1

Polymeric foam extrusion process
[EP 1598164 B9]



Particle density
0,622-0,854 g/cm³



Thermal conductivity
0,077-0,067 W/m* K

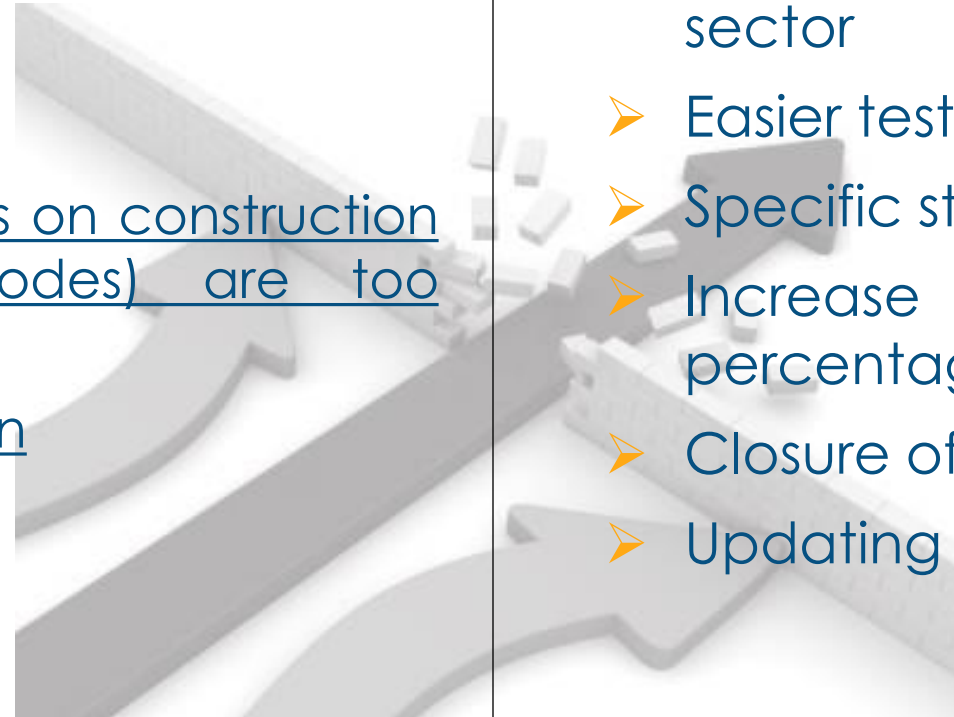
LIMITS AND BARRIERS

The research sector has developed solutions and technologies capable of valorising waste material as aggregate for concrete

- The technical standards on construction (National and Eurocodes) are too stringent
- Lack of clear information
- Cultural gap

POSSIBLE SOLUTION

- Incentives for companies that use high percentages of recycled material
- Greater funds for research in the sector
- Easier testing and certification
- Specific study path and degrees
- Increase in minimum recycled percentages
- Closure of landfills
- Updating sector regulations



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*Thank
you!*

**PAD. B3
STAND 415**

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