Research and Development: New recycling possibilities and solutions

Alenka Mauko Pranjić, Janez Turk, Janko Čretnik, Janez Bernard, Ana Mladenovič, Andrijana Sever Škapin & Peter Nadrah

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ZAG – who we are?

ZAG

SLOVENIAN
NATIONAL BUILDING
AND CIVIL ENGINEERING
INSTITUTE

www.zag.si

Public research institute, 181 employees, 5 departments: Materials, Building Physics, Construction, Road Infrastructure, Metrology, annual turnover: app. 8-10 mio €

Laboratory for Stone, Aggregate and Recycled Materials

- Applicative researches work as well as expert work, consultancy and supervision in the following area:
  - Aggregate (natural, recycled, manufactured) and stone (natural, aggregated)
  - Environmental Engineering: recycling and remediation (water, soil), in-situ immobilization of degraded soil, zero approach in LM
  - Life cycle assessments (E-LCA, S-LCA, LCC) - > EPD
  - Specialized mineralogical (e.g. asbestos, dust in working environments…) and microstructural analysis (microXCT, 3D IA, FE-SEM, rheology, zeta potencial…)
  - Industrial symbiosis, cultural heritage

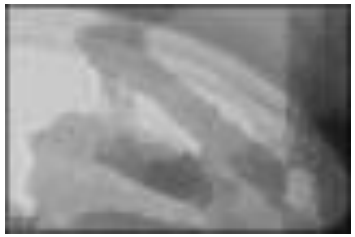




Laboratory for Polymers

- Quality control of:
  - polymeric materials and their certification
  - the installation of polymeric products
- Determination of the condition of installed polymeric materials in the construction industry and of the reasons for their degradation,
- Support to industry
- Research work: photocatalytic coatings and hardeners for the external surfaces of buildings, nanomaterials for use in construction products, and technological procedures for the recycling of construction materials.



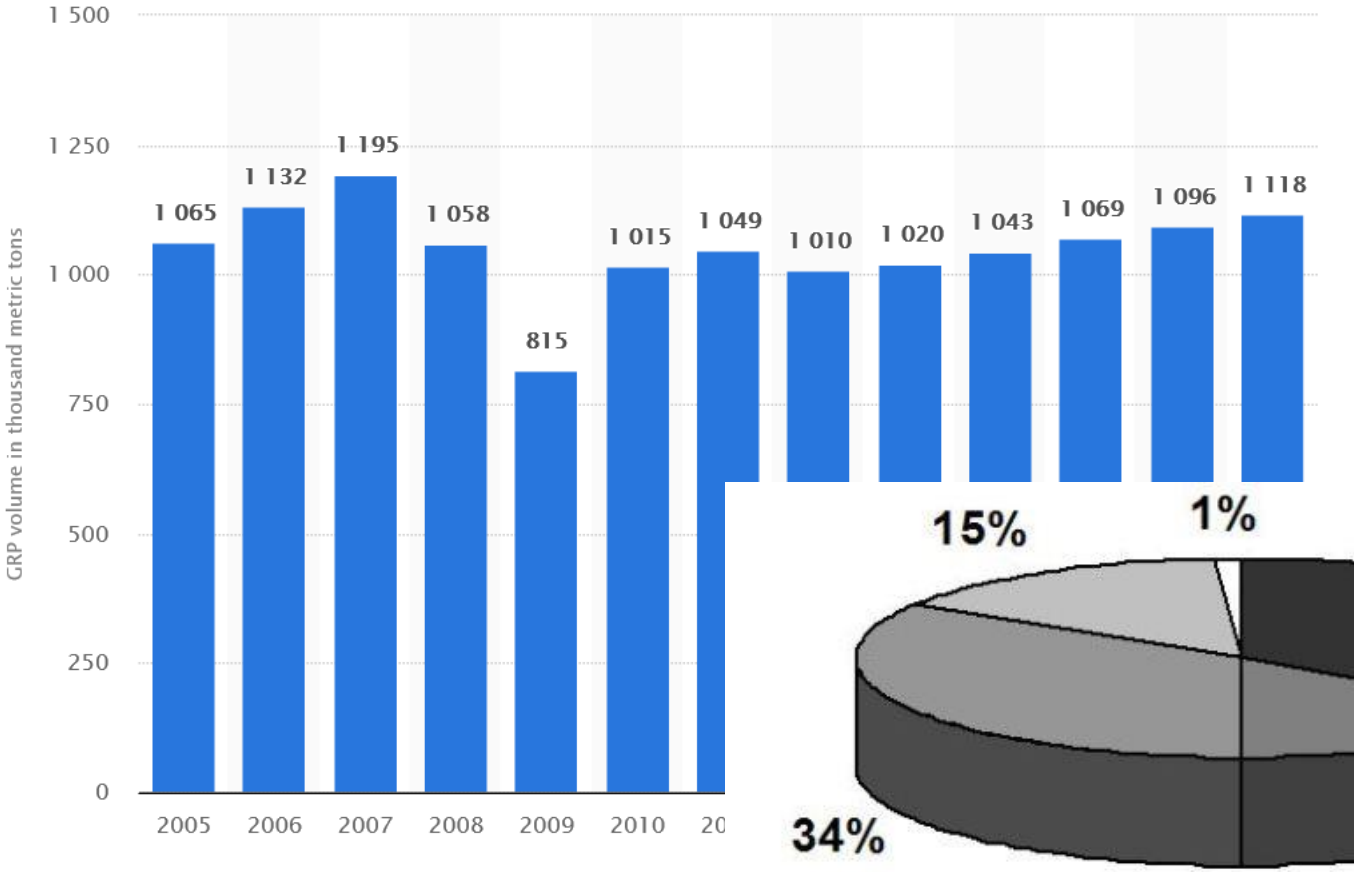




Fiber reinforced composites

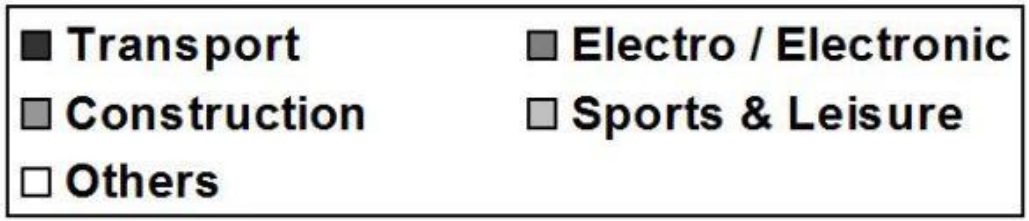
- FRC = a composite material made of a polymer matrix reinforced with fibres (in our case glass fibres). The reinforcements impart strength and stiffness, while the resin is an adhesive matrix that bonds the fibers.
- Properties:
  - Light weight
  - High strength-to-weight ratio
  - Design freedom
  - High levels of stiffness
  - Chemical resistance
  - Good electrical insulating properties
  - Retention of dimensional stability across a wide range of temperatures

www.plasticeurope.org.

- Commonly used in the:
  - aerospace,
  - automotive,
  - marine,
  - renewable energy,
  - construction industries,
  - chemical plant and pipes,
  - sport.



GRP (glass fibre reinforced plastic) volume in Europe since 2005 in ‘00 (www.statista.com)



	2014* Kt	2013 Kt	2012 Kt	2011 Kt	2010 Kt
UK / Ireland	146	140	134	126	130
Belgium / Netherlands / Luxembourg	43	42	43	42	40
Finland / Norway / Sweden / Denmark	42	44	44	52	50
Spain / Portugal	154	152	160	200	217
Italy	148	146	152	165	154
France	108	112	117	122	116
Germany	200	192	182	172	161
Austria / Switzerland	18	17	17	17	16
Eastern Europe**	184	175	161	153	131
Sum:	**1.043**	**1.020**	**1.010**	**1.049**	**1.015**
Turkey***	225	214	195	180	

Fig. 3: GRP production volumes in Europe – and Turkey – itemised by country/group of countries (www.plastics.gl)

Waste 2 product – 7th envir. program.

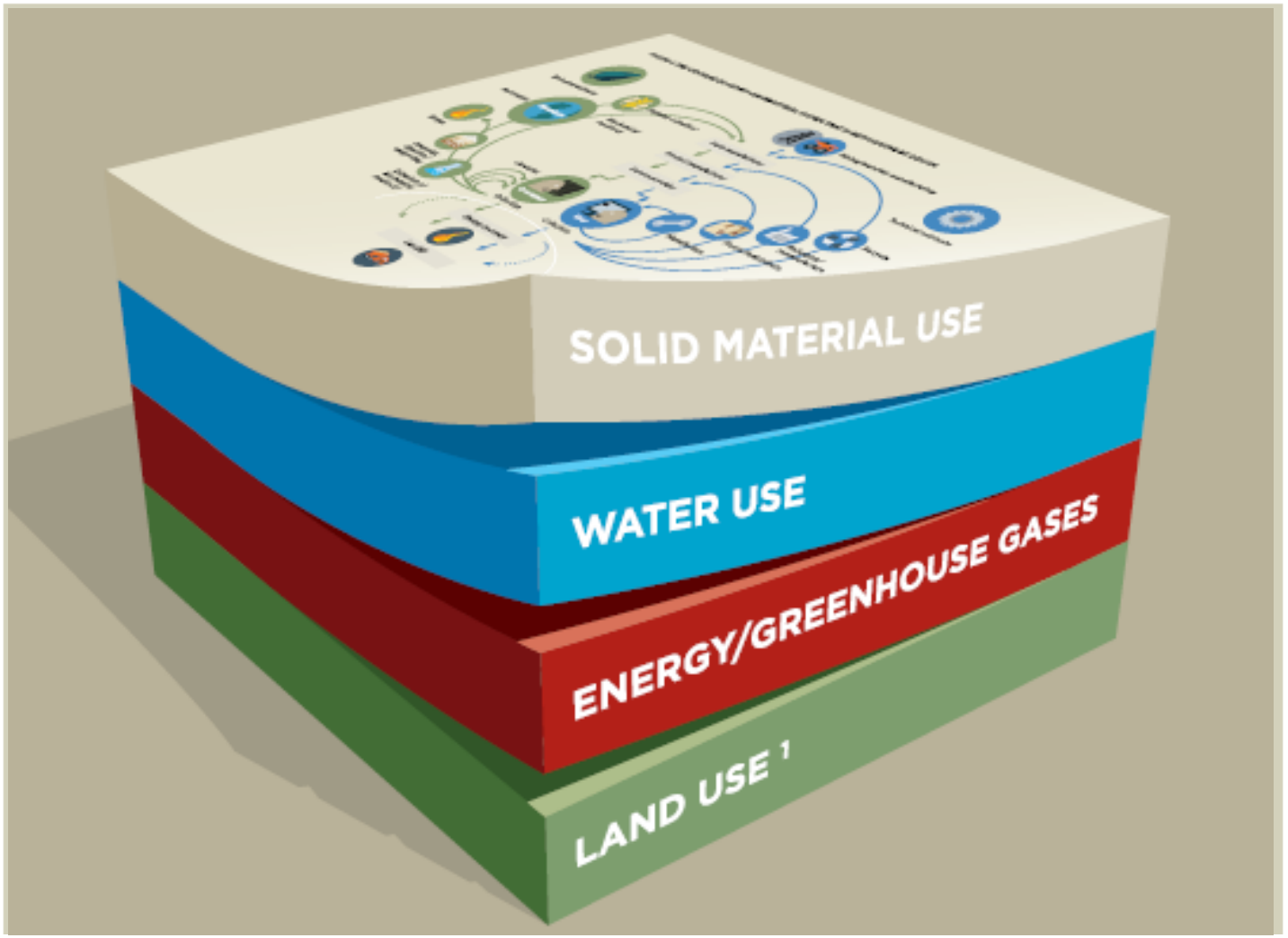
Source:
http://ec.europa.eu/environment/waste/framework/

Europe 2020

- **SMART**
- **SUSTAINABLE**

  A resource efficient Europe
- **INCLUSIVE GROWTH**

Closing the loop! Circular Economy Strategy*, dec. 2015



*COM(2015) 614 final. Closing the loop - An EU action plan for the Circular Economy. 2.12.2015
Figure Source: Ellen MacArthur Foundation Towards the Circular Economy vol.1

Sustainable development goals

25/9/2015 – countries adopted a set of goals for next 15 years to end poverty, protect the planet, and ensure prosperity for all.

THE LAZY PERSON'S GUIDE TO SAVING THE WORLD

Challenges of using sec. RM

- Legislation and standardization ensuring the quality of secondary raw materials (e.g. definition of end-of-waste criteria)
- Abundance of materials
- New processes, innovations
- Measuring efficiency
- Capacity building
  (T-shaped students)

Going out of comfort zone

ReBirth
Odpadek je začetek novega!

Waste

(construction) product

Environemntal legislation

(construction) product legislation

Ways of recycling FRC

- **Mechanical grinding** -> aggregate of different fractions as filler
- Pyrolisis -> glass fibres
- Cement kiln route
- Fluidised bed – glass fibres with lower strenght

http://www.jeccomposites.com/knowledge/international-composites-news/recycling-fibre-reinforced-plastics

Construction sector is encouraging resource efficiency!

- Roadmap to Resource Efficient Europe* includes the following milestones for construction sector:

„By 2020 the renovation and construction of buildings and infrastructure will be made to high resource efficiency levels. The Life-cycle approach will be widely applied; all new buildings will be nearly zero-energy and highly material efficient and policies for renovating the existing building stock will be in place so that it is cost-efficiently refurbished at a rate of 2% per year. 70% of non-hazardous construction and demolition waste will be recycled“

*Roadmap to Resource Efficient Europe

[1] COM(2011) Final Communication from the Commission: Roadmap to a Resource Efficient Europe

Construction Products Regulations (CPR)

NEW! Basic requirement # 7
SUSTIANABLE USE OF NATURAL RESOURCES

7. Sustainable use of natural resources

The construction works must be designed, built and demolished in such a way that the use of natural resources is sustainable and in particular ensure the following:

(a) reuse or recyclability of the construction works, their materials and parts after demolition;

(b) durability of the construction works;

(c) use of environmentally compatible raw and secondary materials in the construction works.

Potential applications in construction – façade panels

- Panels for façade: EN 15286: Agglomerated stone - Slabs and tiles for wall finishes (internal and external)
- Total façade kit (with subframe, fixing)- ETAG 034: Cladding Kits:
  - Part 1: Ventilated Cladding Kits comprising Cladding components and associated fixings
  - Part 2: Cladding Kits comprising Cladding components, associated fixings, subframe and possible insulation layer

- CPR EU 305/2011:
  - Declaration of performance and CE marking
  - Assessment and verification of constancy of performance
  - Harmonised EU standards or ETA

- Esential requirements:
  - ER1: Mechanical resistance and stability
  - ER2: Safety in case of fire (**reaction to fire, fire resistance**)
  - ER3: Hygiene, health and environment (indoor dampness, **outdoor environment**)
  - ER4:Safety of use (**impact resistance, shatter properties, point loads,** wind resistance, seismic resistance, **behavior under hygrothermal reaction**…)
  - Protection against noise
  - Energy, economy and heat retention
  - Aspects of durability and serviceability (**kit durability, movements of the substrate, durability of components**…)

Contact: Alenka Mauko Pranjić, alenka.mauko@zag.si

Project partners

Polo Tecnologico di Pordenone (IT)

Gees Recycling (IT)

Zavod za gradbeništvo Slovenije (SLO)

Infordata Sistemi Srl (IT)

Gospodarska zbornica Slovenije (SLO)