ECONOMIA CIRCOLARE IN EDILIZIA

Relatore
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I prodotti da costruzione da materiali riciclati di demolizione e di risulta

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HeidelbergCement has committed to doing more with less
How are we circular?

- **Co-processing**: in clinker production the fossil fuels are replaced by alternative fuels, thus wastes with high caloric values.

- **Alternative materials**: as raw materials we use a variety of wastes from other industries.

- **Recycling**: concrete as final product is 100% recyclable either as aggregate in concrete or as road base.
Cement production is at the heart of industrial ecology

HeidelbergCement recovers finite resources to minimise primary energy consumption
Circular economy and resource efficiency at product level

Focus on life cycle opportunities in resource efficiency:

- Alternative fuels & raw materials
- Advanced recycling technologies

Architectural design material

- High performance, highly flowable cement mortar for non-structural architectural precast elements
- 80% recycled aggregate
- **fully recyclable** after use as an inert material
- use of photocatalytic additives (TX-Active) for reduction of air pollution

We apply Life Cycle Thinking in research and product innovation.
Nuove sollecitazioni

Bruxelles: nel cuore dell’Europa
Esperienze europee nell’utilizzo di aggregati riciclati

Figure 1: Aggregates Production (in million of tonnes by country and type)

UEPG – 2016 data
Use of recycled concrete aggregates is a consolidated practice

- Backfilling and earthwork
- Road construction
- RCA for asphalt materials
- Land reclamation
- Precast concrete products
- RC Concrete

In the Netherlands

**Fig. 4.2: Geusseitbad Maastricht**
Built with 3500 m³ Ecocrete®100 delivered by Mebin and containing 750m³ of Ecocrete®

**Fig. 4.3: FAXX Building Tilburg**
Built with 100% RCA in foundation beams, 60% RCA in foundation piles, 20% RCA in hollow core slabs, 100% RCA in prefabricated components delivered by Mebin

Ecocrete®, commercialized by Mebin in 2013, is available with up to 100% coarse RCA. Performances are comparable to traditional concrete, and the material is consequently suitable for most applications.
Use of recycled and industrial aggregates in Europe is regulated by law and standards

- About the composition of recycled concrete aggregates (RCA):
  - thresholds for impurities such as for clay, glass, wood, plastic or rubber need to be met
- About use of RCA in concrete, regulations typically:
  - specify permitted concrete exposition classes
  - specify the permitted range of concrete strength classes and % substitution
  - exclude the use in certain applications, such as in Germany in pre-stressed concrete and in lightweight concrete
  - limit or exclude the use of recycled fines

- Sustainable construction rating schemes (voluntary) and Green Public Procurement (mandatory) promote reuse of recycled and industrial aggregates
Case story – Italy
use of industrial aggregates and CDW aggregates

Bologna site: Project with CDW Aggregates – Municipal Building Regulation

Vicenza site: Project with industrial aggregates – LEED v.2009

Regulations in Italy for recycled and industrial aggregates utilization in concrete:

- NTC (mandatory):
  - Limits for Coarse Recycled Aggregates
    - D.M. 17/01/18 Tab. 11.2.III
  - No limits for industrial aggregates

- Standard UNI 11104 (voluntary):
  - Limits for Coarse Recycled Aggregates
    - Table 4
  - No limits for industrial aggregates
The building code of the municipality of Bologna rewards projects that use recycled materials, allowing to increase the volume built.

Based on project requirements, different mix designs have been developed:
- an average of 26% recycled content was provided for non structural Concrete (RCK 15), Foundation Piles/Beam (RCK25), Foundation Pit (RCK 30)
- CDW average content in aggregates: 22% volume

<table>
<thead>
<tr>
<th>Performance Levels</th>
<th>improvements</th>
<th>excellence</th>
</tr>
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<tbody>
<tr>
<td>% volume of aggregates reused or recovered over the total volume of aggregates used</td>
<td>15%</td>
<td>35%</td>
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<tr>
<td>Maximum extension of Current Total Volume</td>
<td>10%</td>
<td>20%</td>
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Bologna specifications

- **Project Scope**: construction of new residential building
- **Design requirement**: compliance with Bologna Municipality Urban Building Regulation - reuse of CDW materials up to 20%
- **Total concrete volume**: 346 mc
Vicenza LEED certified project

- **Project Scope:** enlargement of Ederle NATO Military Base - Vicenza Italy

- **Design requirements:** compliance with LEED MR4-MR5:
  - reuse of materials up to 10%
  - regional materials (distance < 350 Km)

- **Total concrete volume:** 11,445 mc

- **Materials:**
  - Electric arc furnace slag with ISO 14021 certified 100% post-consumer from production site of Tenaris Dalmine
  - Total average recycled content 11.3% (more than 15% in foundations)
Experience gained: learning by doing and cooperative approach

- Need to **ensure access** to recycled concrete aggregates through:
  - Partnership with recycling companies (e.g. joint ventures concrete- locally based recycling companies)
  - Self-sourcing (returned concrete from RMC production,..)

- **Review standards** for more flexible use of CDW aggregates while maintaining adequate aggregate quality controls

- Promote **increase in demand** in particular public procurement tenders and projects pursuing rating schemes

- Collaboration in **capacity building** and promotional activities with associations and designers/ architects

- Product **portfolio enlargement** with branded green products under a specific product labelling and EPD availability
Adding CO2 to waste to produce light-weight aggregates

- CARBON8 Estonia project: carbonating CaO-rich ashes with CO2 produces light-weight aggregates
- 70k tonnes of aggregates part of HeidelbergCement Estonia sales
- EUR 3m investment by HeidelbergCement
- Construction and permitting planned for 2019
Demolizione e riciclaggio del calcestruzzo: riutilizzo di macerie ma anche delle polveri.
La chiusura del ciclo

- Concrete recycling focuses today on coarse aggregate
  - Crushing technologies were designed for natural stone
  - Natural stone is typically homogenous
  - Concrete is inhomogeneous: aggregate and cement stone with different hardness
  - Crushing forms Recycled Fines consisting of paste and sand
  - Fines are recognized as problematic material because of:
    - lower densities
    - water absorption
    - contamination
    - impurities
- Necessita’ di migliorare le tecniche di separazione
The Projects: external activities on European level

Latest new technologies are handled in the following projects:

- C2CA project: ADR (Advanced Dry Recovery)

- HISER project: upscale ADR + HAS (Heating Airclassification System)

- VEEP project (2016-2020): upscale a mobile HAS plant
**New technologies**

**ADVANCED TECHNOLOGIES FOR THE RELEASE AND IMPROVEMENT OF CONCRETE WASTES**

**Release and improvement through ADR combined with HAS:**

1. **Fluidized bed reactors**
2. **Heating-Air classification System (HAS)**
   - Separation and thermal-mechanical treatment of wet and contaminated 0-4 mm fraction
   - Heating of the 0-4 mm and milling to concentrate more cement into the 0-0.125 mm fraction

**Advanced Dry Recovery (ADR)**
- Release of fine fractions 0-4 mm from wet coarse concrete wastes
- Use of kinetic energy to break the bonds formed by moisture.
Un nuovo modello di business

- Come assicurarsi l'accesso a materiali da demolizione di qualità e ampliare le tipologie di materie prime a condizioni economicamente vantaggiose?
Sfida 1: disponibilità e competitività dei costi del calcestruzzo riciclato

- Material is typically only available in small quantities related to individual deconstruction projects arising throughout the country (mostly in urban areas)
- Some bigger quantities are only available if e.g. infrastructure or industrial sites are demolished
  - Stationary or mobile recycling plant?
- Primary raw material is, in many cases, still relatively cheap
Challenge 2: Our place in the value chain

- Where do we see ourselves in the value chain?
- Do we want to enter the demolition market or do we focus on crushing and screening only?
- Do we focus on concrete recycling only or on mineral demolition waste in general?
Challenge 3: How do we secure material flows?

- Make an in-depth market study
  - Example REWINN / NL: Initial business model assumptions vs. real business situation

- Calculate backwards from delivered price to ex works price - costs

- Use vertical integration as distribution channel
  - Are there quality constraints / certificates necessary for using the coarse aggregate in concrete?
  - Do local standards allow the use of the recycled sand in concrete?
Concluding remarks

- The cement industry keeps working with stakeholders to:
  - identify practices that make co-processing waste a safe and eco-efficient operation as well as
  - identify proper waste streams to be used as alternative raw materials in cement or artificial aggregate in concrete

- Public support, including from local authorities, is needed to allow for urban mining

- Recycled content in construction materials should be promoted, considering the whole life cycle approach from raw materials to demolition of the building

- Key players are ready to deliver solutions to society for the transition to circular economy
Grazie per l’attenzione.

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