



Smart Construction and Demolition Wastes

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Smart solutions for a sustainable future of our cities, 19 February 2019

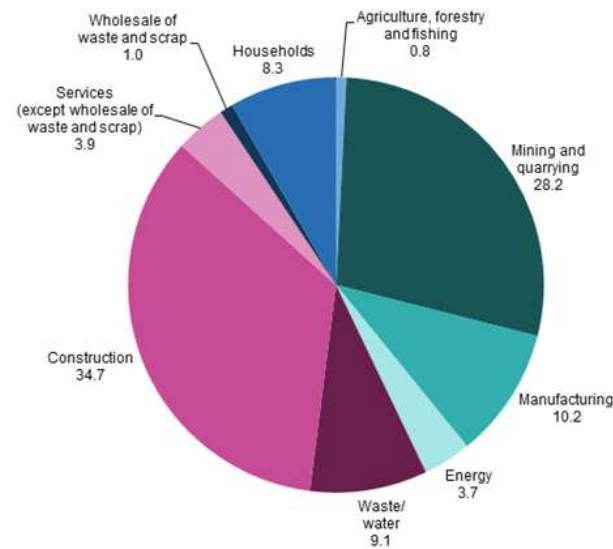
Global context





Global context

- ▶ 2050: 75% population living in cities
- ▶ We produce wastes
 - In EU28 countries, the total waste production by economic activities and households accounted for **2.50 billion tons** (4931 kg per capita) in 2014. **CDW** is estimated to **34.7 %** of the total wastes.



Source: Eurostat (online data code: env_wasgen)



Global context

- ▶ We need construction materials (aggregates)
 - For the EU28 plus EFTA countries, the total 2015 **aggregates production** is estimated just on **2.66 billion tons**. The primary materials came from 26,000 quarries and pits, operated by 15,000 companies (UEPG, 2018, <http://www.uepg.eu/statistics/current-trends>)



2015 National Production by Country (mt)

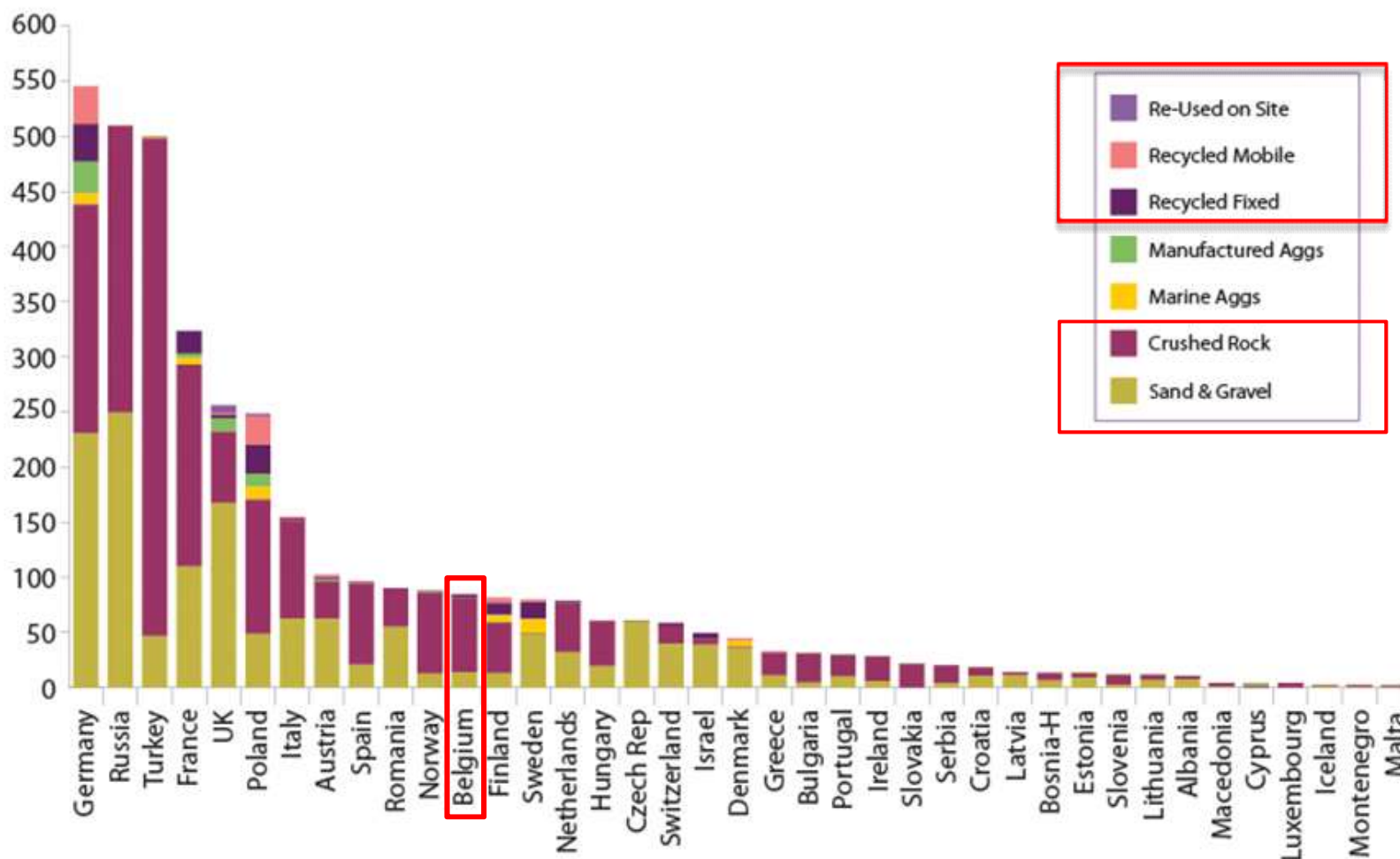
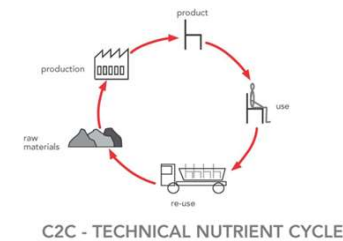


Figure 1 Aggregates Production (in millions of tonnes by country and type)



Objectives

- ▶ 3R: Reduce, Reuse and **Recycle**
- ▶ Using CD&W as sub-base and base material in road construction (“less noble”)
- ▶ Meeting Sustainable Development Goals: recovery targets to **70%** of construction and demolition wastes (CD&W) by **2020** in European Union (**Directive 2008/98/EC**)
- ▶ Reducing use of natural aggregates (preservation of natural resources)





Brakes and obstacles

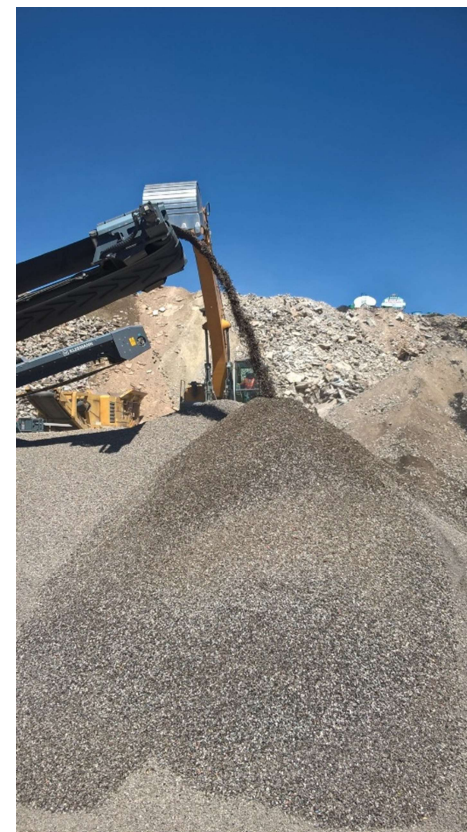
- ▶ Strong legal framework enabling a good level of C&DW management leading to higher recovery rates of C&DW
- ▶ Tracimat in Flanders: 
 - from selective demolition to production of recycled aggregates with higher quality;
 - certification system to guarantee the quality of RA and RS
- ▶ Sorting requirement for C&DW (e.g. ban for polluted soils, asbestos...) and **upcycling!**
- ▶ Green public procurements in construction and recycling quotas in materials used for construction
- ▶ Banishment for landfilling of CDW in Wallonia 



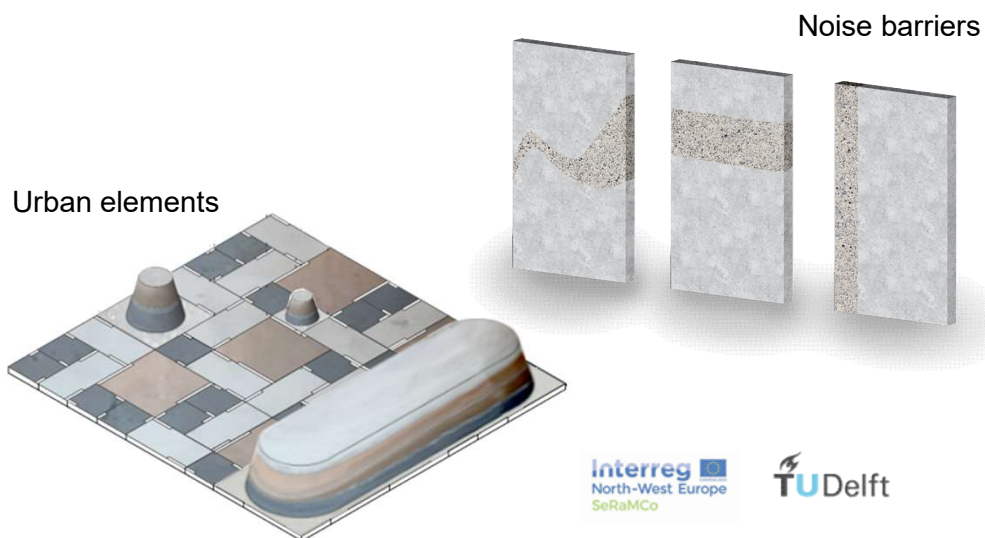
Brakes and obstacles



- ▶ (2013) Obligation to establish a plan for recycling (*NOM-161-SEMARNAT-2011*)
- ▶ Plan de Manejo de Residuos de la Construcción y la demolición (*Cámara Mexicana de la Industria de la Construcción*)
- ▶ Good quality materials (*Concretos Reciclados S. A.*)
but
- ▶ Increasing number of recycling plants (only 1 for 9 million inhabitants ↔ > 80/ 11 million inhabitants)
- ▶ Developing adapted products



Concretos Reciclados, Feb. 18, 2019





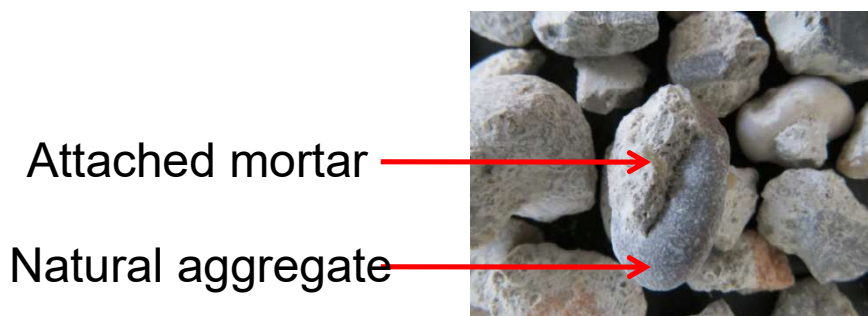
Material processing





Innovative techniques: cleaning aggregates

For **crushing and cleaning** aggregates from concrete



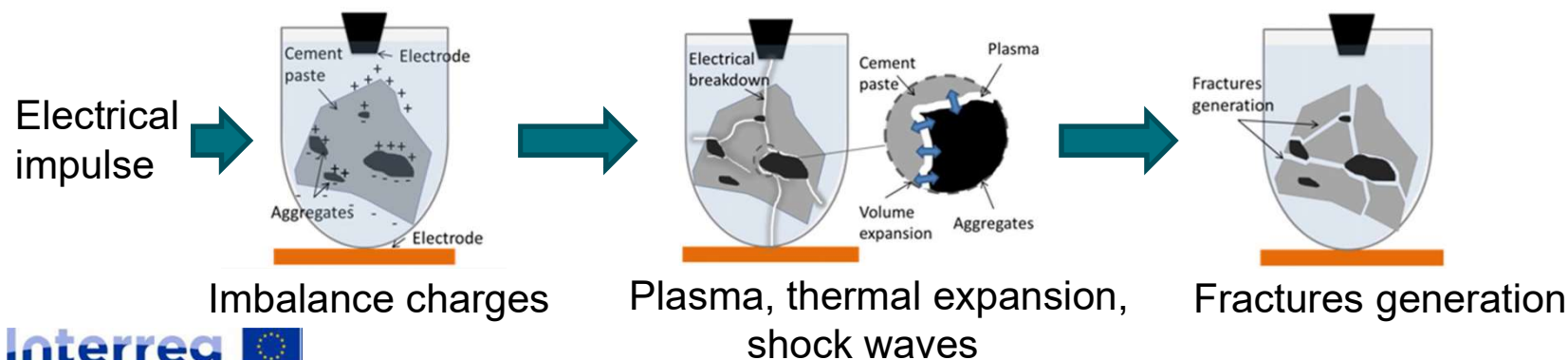
How to clean aggregates?

Bonifazi et al., 2018

Different techniques:

Microwaves, thermal heating, sonic impulses, **electro-dynamic fragmentation (EDF)**

EDF: high liberation rate of clean aggregates up to 80% of the fraction 2-20 mm





Innovative techniques: sorting aggregates

For **sorting** the different components of a mixed source

Mixed aggregates



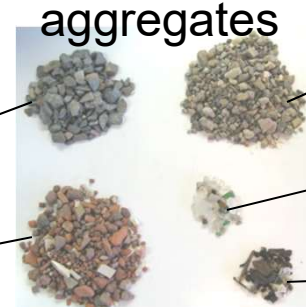
How to sort?



Sorted aggregates

Natural aggregates

Bricks, tiles, ceramics



Concrete, mortar

Glass

Wood, paper, plastic...

Different techniques:

Jigging (**density sorting**)



↑ Stratification by density decreasing upwards

Hyperspectral imaging sensing devices (**optical sorting**)



In the near-infrared range



From block wastes to new blocks



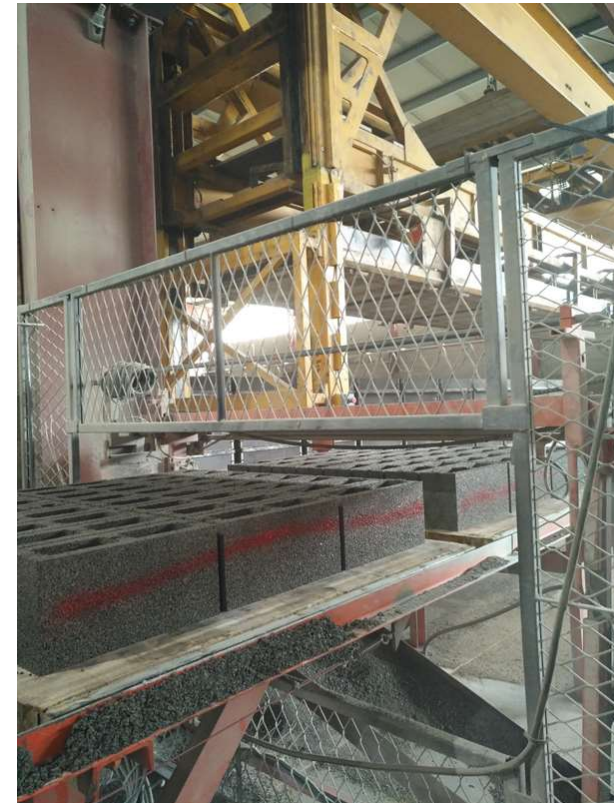
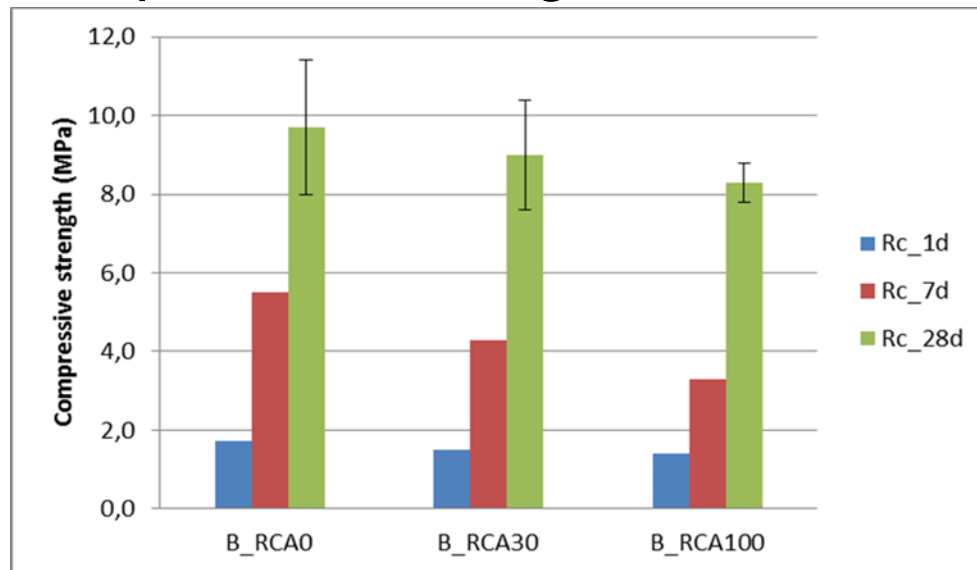
- ▶ RCA manufactured in laboratory
 - Old concrete from block wastes (C8/10 from Prefer Company)
 - Crushing (jaw crusher in laboratory, opening $\approx 10\text{mm}$)
 - Separation of RCA by sieving (0/20mm)
 - Four granular classes: 0/2 - 2/6.3 - 6.3/14 - 14/20





Properties

► Compressive strength



- Compressive strengths of concretes with RCA are slightly lower than those of concrete with natural aggregate
- Compressive strength of concrete made with 100% RCA at 28 days is 8 MPa (14.4% decrease)



Municipal solid waste incineration

1000 kg waste → 200 kg
Municipal Solid Waste
bottom ash residues

Burning at 900-1000°C

After cooling operations



Supply



Cribling

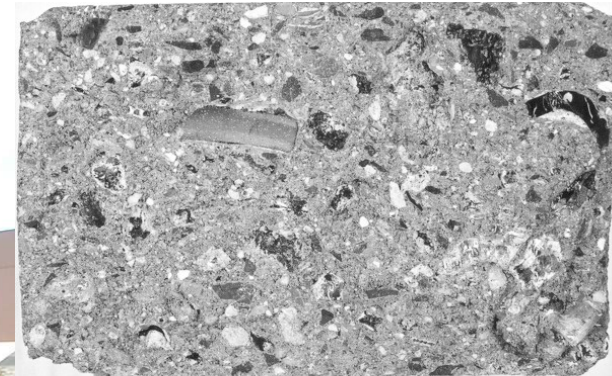
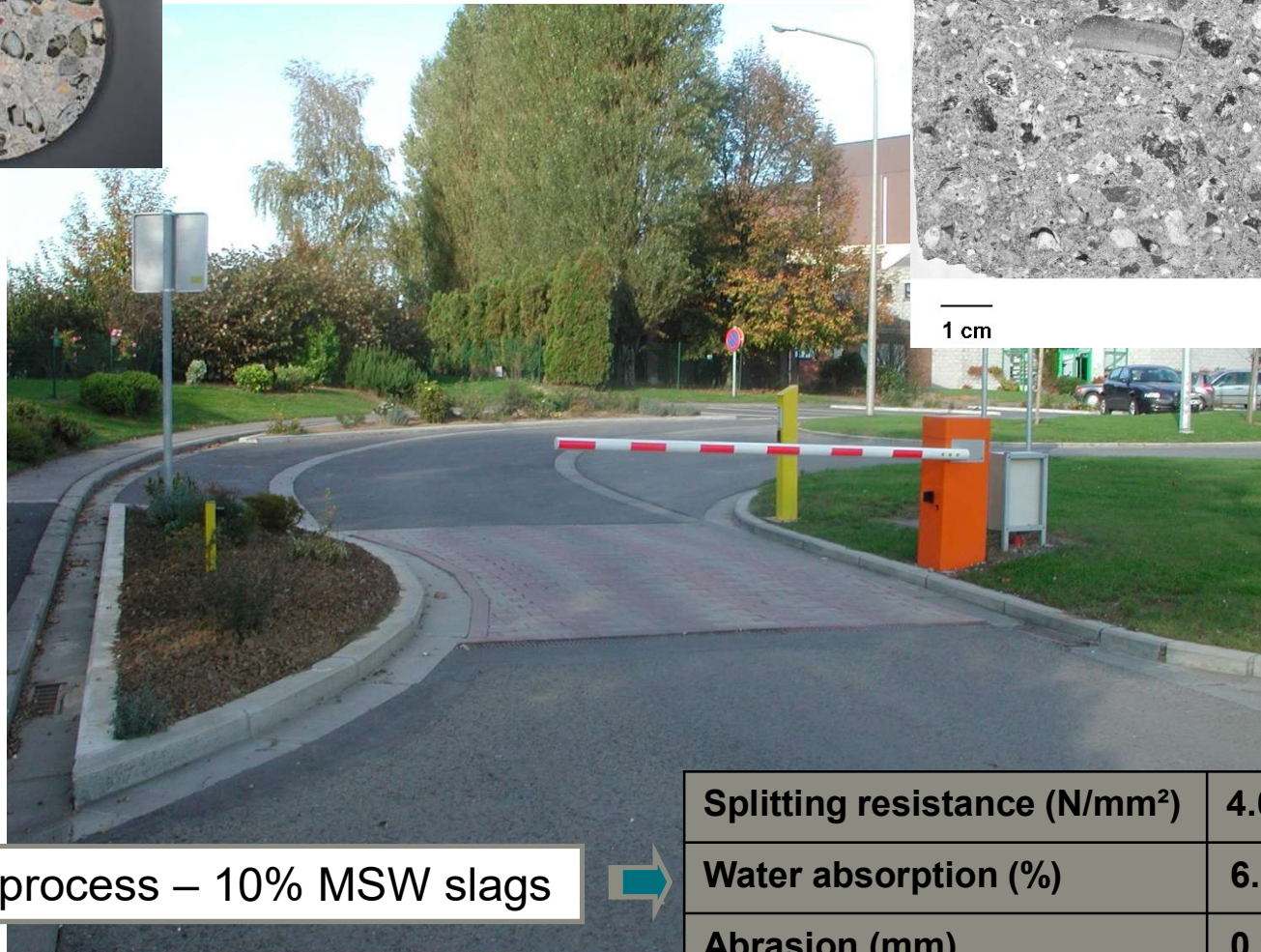


Magnetic separator



Storage (10-20 weeks)

Municipal solid waste incineration



1 cm

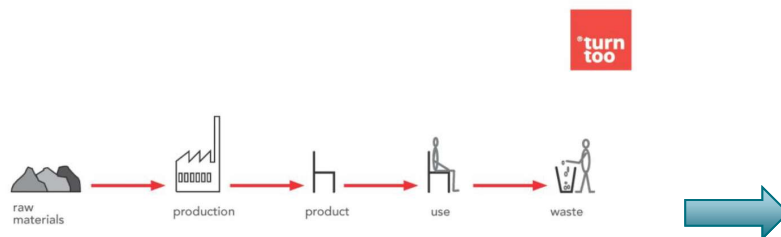
Industrial process – 10% MSW slags

Splitting resistance (N/mm ²)	4.05 ± 0.53
Water absorption (%)	6.61 - 6.29
Abrasion (mm)	0.98 - 1.36

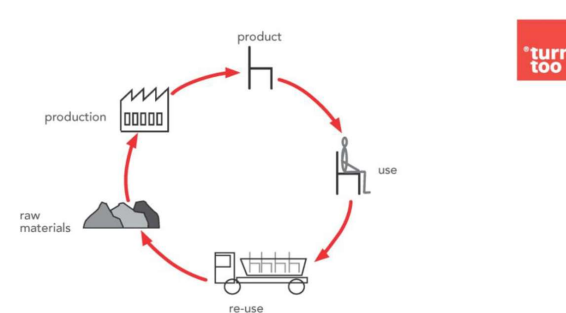


Conclusions

- ▶ Smart approach for constructions
 - Reduce: new design codes (reduce materials and wastes)
 - Reuse: dismantling and deconstruction
 - Recycle: deposit ↔ market
 - Reduce transportation
- ▶ Cradle to cradle



OLD LINEAR ECONOMY - is about ownership



C2C - TECHNICAL NUTRIENT CYCLE



Aknowledgement



ECOLISER

FEDER



Wallonie



FÉDÉRATION
WALLONIE-BRUXELLES

LE FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL, LA WALLONIE
ET LA FÉDÉRATION WALLONIE-BRUXELLES INVESTISSENT DANS VOTRE AVENIR