GYPSUM RESIDUES IN RECYCLED MATERIALS

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▶ RESEARCH INFORMATION

KEYWORDS
Gypsum, recycled concrete aggregates, sulfate attack

INTRODUCTION
Globally, half a ton of construction and demolition wastes (C&DW) are generated per person per year. Reusing this waste into new concretes would prove a big advancement for the construction industry. But up to now, most European countries do not yet implement a real circular economy (figure 1).

Fine particles present in this waste may cause problems, making it harder to reuse them in the manufacture of concrete or other applications. These problematic fine particles are often contaminated with substances such as bitumen, wood, glass, gypsum or organic matter. Some of these contaminants are harmful to the durability of concrete. Gypsum, or $CaSO_4.2H_2O$, is a factor that can threaten the chemical and mechanical stability of cement-based materials via a process called sulfate attack.

Sulfate attack, and the related Delayed Ettringite Formation (DEF), is a deteriorating process that causes the expansive formation of sulfate containing minerals, such as ettringite (figure 2). The high volume of these minerals will cause an expansive stress within the concrete, with degradation and cracking as a result (figure 3).

QUESTION & GOAL
In this project, we research how much residual gypsum contamination from demolition waste is acceptable for designing new concretes. Providing a better understanding of the effects of sulfate attack in the context of demolition waste will promote the use of these recycled materials in the building sector.

METHODOLOGY
1. The fraction 0/4 mm of C&DW from different recycling companies will be analyzed to determine the amount of gypsum contamination.

2. Mortars will be manufactured where different parameters (cement type, curing humidity, …) are varied to assess their influence on the swelling process.

3. The development of sulfate attack will be followed with several analytical techniques (SEM-XRD, oedometer tests, petrography, …).

4. A quantitative relation will be developed to relate the sulfate content of the waste with the volumetric deformation of the recycled building material.

PROSPECTS
Literature shows that DEF is a process that may severely damage concrete structures. The incorporation of fine recycled particles may lead to an acceleration of this degrading process and is up to now generally avoided. The long term behavior of these particles inside concrete will be investigated in an attempt to valorize this flux of materials.

▶ REFERENCES
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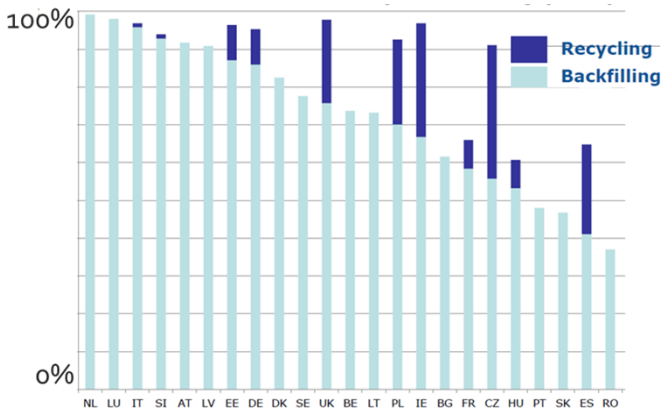
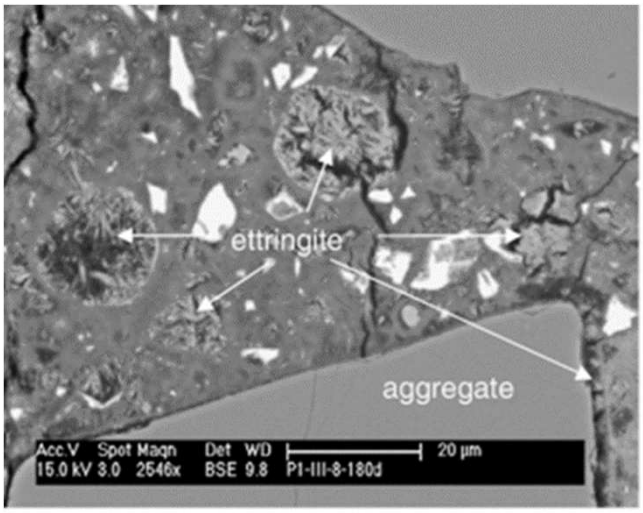


▶ **Fig. 1:** Recycling of construction and demolition wastes in EU countries (European commission, 2011)



▶ **Fig. 2:** SEM picture of ettringite formation following sulfate attack (Schmidt et al, 2007)

▶ **Fig. 3:** The bases of these concrete posts have suffered from sulfate attack (Portland Cement Association, 2002)