ReziProK

Resource-efficient Circular Economy – Innovative Product Cycles

REPOST

Autoclaved aerated concrete recycling cluster: Development of new options for circular economy

Resource-efficient Circular Economy – Innovative Product Cycles (ReziProK)

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REPOST has set itself the goal of creating the basis for a high-quality and economical circular economy of autoclaved aerated concrete (AAC). New and competitive products for masonry constructions are to be created from waste AAC. In addition to direct material recycling, alternative recycling methods – e.g. the production of clinker substitutes – are also being investigated. Ecologically and economically viable business models are being developed on the basis of system analyses.

Powder from post-demolition AAC.

High-quality recycling of AAC

AAC is a building material that has been known and proven for almost 100 years and is also fully recyclable. The recycling of AAC fresh from production, which occurs as cuttings or breakage during production, has been practiced for decades. In contrast, demolished AAC often contains accompanying materials that make high-quality recycling difficult, which is why AAC is usually deposited in landfill after use. Decreasing landfill capacities, legal obligations for the recyclability of products and the protection of primary materials therefore make it essential to find recycling alternatives for this demolition material.

REPOST aims at the reduction of primary raw materials in the production of AAC by recycling AAC at the same or comparable quality level. This concept thus differs from conventional building material recycling. According to statistics, around 90 percent of mineral construction waste was recycled in 2016, but mostly as low-value and one-off down cycling in road construction.

The entire product life cycle at a glance

The REPOST work plan is based on the life cycle of a recycled AAC block and begins with the dismantling and processing of AAC from the existing stock. The central question is which sorting methods are most suitable for obtaining a secondary raw material of the highest possible quality.

The secondary raw material thus obtained is to be used directly as an aggregate for new masonry products. These can be calcium silicate units (CSU) and lightweight concrete blocks or even new AAC blocks.

AAC contains a large proportion of deacidified lime, which was produced with high energy input and high CO_2 emissions. Where recycling within a closed cycle is not possible, thermal conversion into dicalcium silicate, a main component of cement clinker, is being investigated. The aim is to partially replace the primary raw materials cement or lime in the production of AAC with a recycled product that causes lower CO_2 emissions and energy expenditure during its manufacture.

With the involvement of building owners, demolition companies and processing companies, business models for the new recycling options are being developed over the entire life cycle.

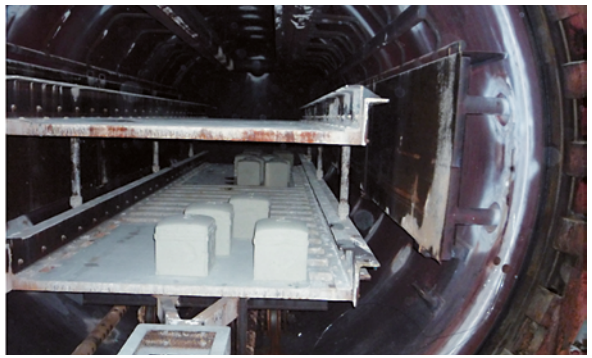
First results

At project start, Otto Dörner delivered 25 tons of pre-sorted post-demolition AAC to the Xella granulate plant in Rotenburg/Wümme. After a visual inspection for critical foreign matter the material was subjected to crushing. The resulting AAC-powder was free of pollutants according to LAGA M20, TR Boden, so that from a chemical point of view there were no application restrictions for its utilization.

First application tests to produce belite using the Resynergy process were successfully completed at the KIT-ITC.

Various recipes for the production of new AAC or calcium silicate units using post-demolition AAC were developed at the pilot plant of Xella's R&D-Center. It could be demonstrated that standardized or approval-relevant material parameters can be achieved without any effort up to certain added quantities. In the next step, these results are to be validated by upscaling in selected production plants.

By means of modelling, site-specific (at district level) volumes of post-demolition AAC that would accrue by 2050 were determined by KIT-IIP. Currently, the IIP is working on the techno-economic analysis of all considered recycling options for post-demolition AAC as well as on the modelling of possible circulation systems.



AAC small-scale test specimen after hydrothermal curing

Applied and basic research

The Hamburg-based company Otto Dörner Entsorgung GmbH will focus on the sorting of AAC in various quality grades and will provide the project partners with waste AAC for the development of recycling products.

The chemists from the Institute of Technical Chemistry (ITC) at the Karlsruhe Institute of Technology (KIT) will adapt the process developed and patented there for the conversion of mineral residues to Belit ("Resynergy") for the starting material AAC.

The Institute for Industrial Production (IIP) of KIT will model the new recycling options in a comparative system analysis. Taking into account the informational, economic, and regulatory framework conditions to be complied with, an assessment is made over the entire life cycle.

Project coordination is carried out by Xella Technologie- und Forschungsgesellschaft mbH, the R&D facility of the AAC and CSU manufacturer Xella. In addition, building material prototypes are developed here on a small and large-scale technical scale and finally transferred to production in selected Xella plants.

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Resource-efficient Circular Economy – Innovative Product Cycles (ReziProK)

As part of the FONA Field of action 6:
The circular economy – efficient use of raw materials, avoiding waste.

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REPOST – Autoclaved aerated concrete recycling cluster: Development of new options for circular economy

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Cover-Picture: Visual inspection of post-demolition AAC (25 t) before crushing/milling: Uncritical accompanying materials such as paint, wallpaper residues, mortar/glue, corrosion protection and one (!) dowel.

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"ReziProK" is part of the research concept "Resource-efficient Circular Economy" of the Federal Ministry of Education and Research (BMBF) as part of the FONA Field of action 6: "The circular economy – efficient use of raw materials, avoiding waste" and supports projects that develop business models, design concepts or digital technologies for closed product cycles.

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