Appendix 1: Research projects in Sweden involving the use of ingredients of biomass origins to produce cementitious materials

Project name	Time	Funding org.	Project leader	Short description	More information
Utilization of pulp mill wastes in cement-based materials: Case study in cooperation with Södra	June 2017-April 2018	Energimyndigheten (Re-Source),	Arezou Babaahmadi, RISE	The project, in partnership with Södra Cell Värö, aims to demonstrate the feasibility of utilizing residual by-products from Swedish pulp mills, specifically bark ash and sludge, in the production of cement-based materials. This collaboration seeks to enhance resource efficiency by repurposing materials currently disposed of in landfills into valuable construction components. By integrating these residuals, the initiative promotes sustainable waste management and contributes to the development of eco-friendly building materials, aligning with the goals of reducing environmental impact and advancing the circular economy within the construction sector.	https://resource-sip.se/projekt/ateranvandning-av-massabruks-avfall-i-cementbaserade-materialer-en-forstudie-i-samarbete-med-sodra/?en
Charcrete - the new black in the field of urban green constructions	June 2020 - August 2021	Vinnova	Biokolprodukter Global AB	The project aimed to develop and introduce charcrete—concrete enhanced with biochar—for urban vegetation systems. It successfully launched Sweden's first charcrete products, including a tree pit foundation and a rain bed inlet plate, with additional products planned for release in autumn 2021. By replacing part of the ballast with biochar, charcrete becomes a more climate-friendly material through the carbon sequestration provided by the biochar.	https://www.vinnova.se/en/p/charcrete---the-new-black-in-the-field-of-urban-green-constructions/
Carbon sink lightweight concrete	December 2021 -	BioInnovation	Biokolprodukter Global AB	The project developed climate-smart cement-based construction products that sequester carbon by replacing some cement ballast	https://www.vinnova.se/en/p/carbon-sink-lightweight-concrete/

	August 2022			with biochar from cocoa shells and mixed wood biomass. Recycled wood biochar available in Sweden did not meet the project's requirements. Laboratory tests, small-scale production, and full-scale factory testing were conducted for two cement-based products. Additionally, biochar preparation methods, including grinding and moistening, were evaluated to identify the necessary milling techniques for future production.	
Use of Wood Ash in Ecological Concrete	July 2021 – July 2023	SBUF, Skanska	Karin Habermehl-Cwirzen, LTU	Pre-treated wood ash (WA), obtained by drying, sieving, and grinding, has been shown to replace 20% of blast furnace slag in alkali-activated systems. Ongoing studies will evaluate the pozzolanic activity of treated WA and its frost durability. The project focuses on developing eco-concrete solutions using WA as a binder replacement in cementitious systems.	https://www.sbuf.se/projektresultat/avhandling?id=499ee0cb-bc88-4946-4a47-08dc07c7bf87&lid=12a96eef-e1d8-45e8-a867-8f6722cab91e
Carbon sink concrete – from potential to tens of thousands of CO2 – step 2	November 2022 - November 2024	BioInnovation	Biokolprodukter Global AB	The project develops climate-smart concrete and cement products that sequester more carbon than their emissions. It aims to use biochar beyond traditional soil applications, creating a stable and traceable carbon sink with charred biomass. Recognizing the high demand for sustainable materials, the project seeks to operationalize the process and establish a local value chain from biomass extraction to the sale of construction products and biochar additives. The ultimate goal is to introduce one or more commercially viable products to the market.	https://www.bioinnovation.se/en/projekt/carbon-sink-concrete-from-potential-to-tens-of-thousands-of-co2-step-2/
Using Sustainable Biochar to Lower the Detrimental Effects of Fire in Concrete	November 2022 -	Brandforsk	Oisik Das, LTU	This project investigated the potential of high-temperature biochar (produced above 700 °C) to enhance concrete's fire resistance and	https://www.brandforsk.se/en/research-projects/2023/using-

	November 2024.			sustainability. The study focused on biochar's microporous structure, expected to aid moisture escape and reduce crack formation under high heat, along with its non-combustible and thermally stable nature. While biochar effectively replaced cement to reduce the carbon footprint, experimental results showed limited impact on fire resistance. Biochar-added and control concrete exhibited similar morphologies and fire behavior.	sustainable-biochar-to-lower-the-detrimental-effects-of-fire-in-concrete/
Sustainable development through biochar-added concrete	January 2023– January 2026	Formas	Oisik Das, LTU	The project explores replacing cement and aggregates in concrete with waste-derived fine and coarse biochar. Concrete samples will be cast and evaluated for compressive and tensile strength, elasticity, microstructure, and chemical composition following standard protocols. The best-performing mix will undergo bond-slip resistance tests with various steel rebars under normal and fire conditions using a universal testing machine. A Life Cycle Assessment and Life Cycle Cost Analysis will quantify the environmental and economic impacts of biochar-enhanced concretes.	https://www.vr.se/english/swecris.html?project=2022-00676_Formas#/
Energy-efficient concrete with bio-based PCMs for improving sustainability in buildings	April 2023 – December 2025	SBUF, Skanska	Ilda Tole, LTU	This project investigates the development of a climate-friendly building material with enhanced thermal performance using bio-based Phase Change Materials (PCM). Two methods for incorporating PCM—impregnation and microencapsulation—will be tested and compared to evaluate their heat storage efficiency, mechanical strength, and economic viability. The findings could pave the way for innovative applications, such as integrating the material into passive house	https://www.sbuf.se/projektresultat/projekt?id=70991512-9eb4-4aa5-bff6-d1a86971318f

				designs to limit freezing and thawing cycles, thereby improving energy efficiency and durability in construction.	