This thesis presents work that was done within the Swedish Centre for Resource Recovery (SCRR). Research and education performed within SCRR identifies new and improved methods to convert residuals into value-added products. SCRR covers technical, environmental and social aspects of sustainable resource recovery.

DOCTORAL THESIS
Resource Recovery

Urbanization causes growth in construction and infrastructure sectors resulting in rapid production of concrete and related waste. This showing as a yearly demand of about 1 billion ton aggregates to produce concrete and 900 million ton of construction waste from the EU alone. Recycled aggregates from construction waste used in concrete is advantageous for ecological preservation of natural aggregates, reduction of waste and landfill. As the commercial production of recycled aggregates for structural concrete in Sweden is yet to be developed, this study focuses on the production of structural concrete from prefabricated concrete waste which has lesser quality variations than mixed construction waste.

This thesis investigates crushed concrete aggregates (CCA) as aggregate replacements in an industrial reference concrete recipe. Overall CCA replacement addresses closed-loop recycling feasible for continuous waste supply. Even a partial aggregate replacement is considered given the likelihood of discontinuous waste supply where fine fractions of natural aggregates are replaced by CCA. Both replacement ratios address technical and practical concerns in Sweden and exhibit novelty and potential of CCA replacement in high-utility recycling.

CCA concrete shows lower compressive strength and workability than reference concrete due to the adhered mortar and flakiness of CCA fractions, different from reference concrete aggregates. This leads to lower aggregate packing density and higher water absorption, crucial for concrete strength and workability. To improve concrete properties, this research firstly conducts mechanical pre-processing to enhance CCA quality by adhered mortar removal. Secondly, investigates paste densification by the addition of secondary cementitious materials (SCM) such as blast furnace slag. Besides the paste densification, SCM also strengthens the unremoved adhered mortar.

Concrete with CCA as overall aggregate replacement achieves reference concrete strength and workability with SCM addition, resulting in a climate-optimized concrete due to reduced carbon dioxide emissions from cement replacement. Concrete with CCA as fine aggregates fulfils the reference concrete requirements as a climate optimized concrete by the combination of mechanical pre-processing and SCM addition. These results give statistically significant improvements on the compressive strength of the concrete.

Electronic version: http://urn.kb.se/resolve?urn=urn:nbn:se:hb:diva-24594
ISBN 978-91-89271-19-7 (printed)
ISBN 978-91-89271-20-3 (pdf)
ISSN 0280-381X, Skrifter från Högskolan i Borås, nr. 117

DOCTORAL THESIS
MADUMITA SADAGOPAN
RECYCLING OF CONCRETE IN NEW STRUCTURAL CONCRETE

RECYCLING OF CONCRETE IN NEW STRUCTURAL CONCRETE

MADUMITA SADAGOPAN

UNIVERSITY OF BORÅS