

Background

Michigan's highway infrastructure is exposed to extreme winters, resulting in harsh freeze-thaw conditions after intermittent saturation and exposure to deicing chemicals. Sustainability of the highway infrastructure will depend greatly on the performance of the unbound and bound materials from which it is constructed, both from a structural and durability perspective. It is thus essential that the materials chosen for sustainable transportation infrastructure do not compromise the structural integrity or durability of the structure, considering not only the environmental impact of that choice, but also the economic and social impacts as well. For example, it is not sustainable to use recycled materials in a way that compromises the longevity of the structure as the social and economic costs of premature failure will outweigh the environmental benefits derived from that use.

It is understood that construction and demolition waste is plentiful and this material has value and should be used in the construction of new transportation infrastructure. The sustainable use of this material will reduce the amount of waste going to landfills, decrease raw material costs, and if done correctly, will not compromise service life. Research to date on the use of RCA has documented incorporating it into transportation applications including soil stabilization, subbase and base courses, and as aggregate in HMA and PCC. Since there is an abundance of RCA and a decrease in abundance of virgin materials, the most sustainable approach is to determine the most effective way to use RCA.

Yet there has been reluctance to use RCA due to its uncertain composition and the impact that this can have on the durability of the finished product. Uses today are limited, often being restricted to access roads, non-structural applications, and precast applications, with fines and fillers going largely unused (Wong, Sun, Lai, 2007). Key factors that must be better understood to increase use of RCA include the amount of debris material available, fines present, amount of residual adhered cement paste, chloride content, freeze-thaw susceptibility, and the potential for ASR.

Environmental considerations are also of high importance. RCA is highly alkaline and contains unknown amounts of chlorides and other substances that can contaminate groundwater during processing operations. Also, when RCA is used in an application, these same substances may result in corrosion of embedded steel as well as become a potential source of groundwater contamination. When combined with binder in HMA, the risk associated with runoff of these substances is limited to a great extent (Wong, Sun, Lai, 2007). These concerns must be addressed for RCA to gain widespread acceptance.

RCA has proven to be more successful when combined with natural aggregates, other combinations of recycled aggregates and/or recycled materials, and/or with fibers that enhance mechanical behavior while resisting corrosion.

Although additional research is needed, sufficient information exists to establish the state-of-the-practice to reduce the uncertainty for engineers and contractors desiring to use RCA in transportation projects.

Study Objective

The central objective of this study is to minimize risks inherent in using RCA as an engineered material in the transportation industry and thus increase the use of this resource.

This study will examine:

- Current national and international practices regarding the use of RCA (including both the coarse fraction and fines) as engineered materials by the transportation industry.
- Current environmental regulations, databases, and compliances used to determine what should be incorporated in MDOT practices.

This study will initiate development of a framework for:

- The development of the supply chain for RCA to encourage its use throughout the industry.
- Education in the form of seminars, workshops, databases, etc., for contractors, designers, corporations, and local governments to resolve industry uncertainties surrounding the use of RCA and ensure regulatory paperwork is as uncomplicated as possible.

This study will also assess the economics of implementation inherent in the operation of a portable processing plant including an on-site crushing operation for recycled concrete including:

- Volume of stockpiled crushed aggregate that would economically justify transportation costs versus bringing in portable plant.
- Costs of waste water treatment from operations.
- Environmental regulations.