BDV31-977-48

M Team Implementation Summary

Disposition of Concrete Grinding Residue (CGR):

Bottom line: FDOT needs to incorporate best management practices for the disposition of this material into our specifications.

- The concrete grinding slurry has a high pH (11.0-12.4).
- Arsenic and Barium content exceed Florida soil target cleanup levels for residential use, but not for commercial.
- Best management practices have been developed by the Concrete Grinding and Grooving Association.
- Several states have implemented such requirements.

Issues associated with the use of Recycled Concrete Aggregate (RCA):

Bottom line: Based on Phase I of this research, the FDOT should issue a Construction/Materials memo that prohibits metal pipe in contact with RCA.

- RCA is becoming more popular for a variety of uses.
- The pH of the water leaching from RCA has a high pH (10.5-12.3).
- pH this high will degrade a number of metal pipe materials.
- Phase I indicates we should prohibit direct contact.
- Phase II will model acceptable proximity based on several variables.
- Phase I confirms the presence of undesirable elements.
- Phase II will evaluate the mitigation of these elements and pH in natural soils.

Executive Summary

Research provided a preliminary evaluation of the potential environmental impacts associated with two Portland cement concrete (PCC) related materials: recycled concrete aggregate (RCA) used as road base and concrete grinding residual (CGR) produced from grinding and grooving operations. Recycled concrete aggregate (RCA) is utilized for road base construction because of its excellent mechanical properties. Several past studies have evaluated possible issues posed by elevated pH and heavy metals in RCA leachate, though only minimal information is available for Florida. Grooving and grinding operations of PCC pavements produce a residual slurry with a 56% to 95% moisture content and an elevated pH. Concrete grinding residual (CGR) slurry has been managed in a variety of ways, including discharge adjacent to roadways and discharge into management-controlled retention ponds.

Laboratory tests were performed on eight RCA samples collected from various recycling facilities across Florida with a goal of examining the pH reached for different liquid-to-solid ratios (L/S) of water and RCA. Measured pH ranged from 10.5 to 12.3, depending on L/S. Through laboratory testing and chemical modeling, some degree of pH reduction was demonstrated for RCA leachate entering the environment as a result of factors such as carbonation from atmospheric carbon dioxide, neutralization with soil acidity, and neutralization with groundwater. Unknowns remain regarding the degree to which natural carbonation will continue to contribute to pH reduction over time. Leaching of heavy metals from RCA was evaluated as a part of literature review. These results, along with past experience on fate and transport modeling for the beneficial use of other waste materials, suggest that most trace elements leaching from RCA will be lower than risk-based regulatory thresholds, and those that do not will likely be attenuated in the environment. But this cannot be definitively concluded for Florida without additional testing of Florida RCA samples and site-specific modeling.

FDOT testing on CGR has found that CGR is not a hazardous waste, but the slurry does exhibit an elevated pH. The pH of CGR samples was measured over a range of L/S, and at different times during sampling and analysis, the pH ranged from 11.0 to 12.4, depending on the amount of liquid present. This pH is sufficiently elevated that appropriate CGR management steps should be required. Total elemental analysis of CGR found arsenic and barium to exceed Florida soil cleanup target levels for residential use, but these elements were well under commercial use thresholds, suggesting that land application of CGR as an amendment should have limited concern as long as application rates are limited. Best management practices for CGR have been developed by the concrete grinding industry, and several state DOTs recognize and require implementation of such requirements. Management of CGR using a similar approach as concrete truck washout is a common practice that should provide appropriate

protection. If CGR is discharged adjacent to roadways, this should only be conducted in a manner protective of adjacent aquatic ecosystems.

Additional research was outlined for an expanded evaluation of possible RCA impacts on Florida's environment and on metal infrastructure that might be exposed to a high pH RCA leachate. RCA samples from throughout Florida should be tested for heavy metal leaching using standardized leaching procedures, as should an examination of the effect of pH on leachability. Additionally, more realistic experimental simulations should be performed to evaluate the interaction of RCA leachate (with its associated pH and trace element content) with natural soils. Key factors that require investigation include soil type, soil depth, and infiltration rate. These experiments should include an examination of the effect of a high pH soil environment under an RCA base on metal piping. All of these results should be included as part of a Florida-specific beneficial use fate and transport model to assess whether any limitations for RCA are warranted, and if so, what should they be.

Table 0.1 Best Management Practices for Concrete Grinding Residue Slurry

Location of CGR generation	Close proximity (within 100 ft.) to surface waters or storm water collection
Precautions	• Use vacuum apparatus to collect CGR slurry from grinding rig • Use tanker truck or equivalent to collect CGR slurry during operation • Do not allow CGR slurry to flow across traffic lanes • Do not allow CGR slurry to flow into any nearby surface waters, stormwater collection systems, or infiltrate into the ground within 100 ft of any nearby water bodies
Disposal	• Must be hauled off site for disposal • May be managed in the same manner as concrete truck washout • An open pit or container may be used to dry the material • Container or liner must have hydraulic conductivity no greater than 10^{-7} cm/sec. Research has shown that even highly acidic soils have only a limited ability to reduce the pH of alkaline water. Introduction of high pH slurry water into natural water bodies should be minimized. • Dried material may be disposed of in a Class II landfill • Dried material may be reused in the production of new PCC • Dried material may be used beneficially in a commercial manor • If material is to be beneficially used, it must be in accordance with a Beneficial Use Permit
Monitoring	• If material is stored in a container for drying, visual leak inspections should be performed at least on a weekly basis • If precipitation is expected to cause an overflow in either container or pit while CGR material is present, precautions should be made to either prevent precipitation from infiltrating the container, or there should be adequate volume to prevent overflow • Anytime CGR material is present in its slurry form, pH reading should be taken at least daily. This is to ensure that the pH is, at no point, greater than 12.5. A pH of 12.5 constitutes a hazardous material, and the material would have to be handled as such.

Table 0.1 Best Management Practices for Concrete Grinding Residue Slurry

Location of CGR generation	Rural areas not in close proximity (further than 100 ft.) to surface waters or storm water collection
Precautions	• Use vacuum apparatus to collect CGR slurry from grinding rig • Use tanker truck or equivalent to collect CGR slurry during operation • Do not allow CGR slurry to flow across traffic lanes • Do not allow CGR slurry to flow into any nearby surface waters, stormwater collection systems, or infiltrate into the ground within 100 ft of any nearby water bodies
Disposal	• When land area permits, CGR slurry may be spread along the side of the road embankment or right of way. CGR slurry that is disposed of in this manor must be spread evenly and at a constant rate to ensure that no single area becomes overburden with CGR material and the high pH of the slurry water. The material that is spread in this manor should be done on to vegetated areas. If the area is not vegetated, efforts should be made to mix the material in with the existing soil. • CGR slurry may be hauled off site • May be managed in the same manner as concrete truck washout • An open pit or container may be used to dry the material • Container or liner must have hydraulic conductivity no greater than 10^{-7} cm/sec. Research has shown that even highly acidic soils have only a limited ability to reduce the pH of alkaline water. Introduction of high pH slurry water into natural water bodies should be minimized. • Dried material may be disposed of in a Class II landfill • Dried material may be reused in the production of new PCC • Dried material may be used beneficially in a commercial manor • If material is to be beneficially used, it must be in accordance with a Beneficial Use Permit

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Monitoring	• If the option to dispose of CGR slurry on site is chosen, the pH of the slurry water must be taken first. The pH must be less than 12.5 to ensure that the material is not a hazardous material. • If material is stored in a container for drying, visual leak inspections should be performed at least on a weekly basis • If precipitation is expected to cause an overflow in either container or pit while CGR material is present, precautions should be made to either prevent precipitation from infiltrating the container, or there should be adequate volume to prevent overflow • Anytime CGR material is present in its slurry form, pH reading should be taken at least daily. This is to ensure that the pH is, at no point, greater than 12.5. A pH of 12.5 constitutes a hazardous material, and the material would have to be handled as such.