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| UTC Project Information – National UTC TriDurLE |
| Project Title  | Design of Long-Lasting Discrete Sacrificial Anode for Corrosion Mitigation of Reinforcement in Chloride Contaminated Concrete |
| University  | Washington State University |
| Principal Investigator  | Xianming Shi |
| PI Contact Information  | Phone: 509-335-7088Email: xianming.shi@wsu.edu; |
| Funding Source(s) and Amount Provided (by each agency or organization)  | UTC funding and Matching Funds from Washington State University |
| Total Project Cost  | $108,000 |
| Agency ID or Contract Number  |  |
| Start and End Dates  |  05/01/2020 – 09/31/2021 |
| Brief Description of Research Project  | Reinforcement corrosion induced by chloride contamination is a leading cause of structural damage and premature degradation in reinforced concrete (RC) structures, with significant implications for safety, reliability, economics, and environmental performance. Discrete sacrificial anode (DSA) is one tool used for corrosion mitigation of steel reinforcement in chloride contaminated concrete, particularly through embedment in repair mortar to reduce the detrimental “ring effect”. Our recent study revealed that the commercial DSA products actually have much shorter service life than expected, because zinc corrosion products accumulate at the interface between zinc core and the packaged mortar, reduce the current supply to steel reinforcement, crack the encased mortar, and finally lead to the complete failure of the DSA. In this context, the overarching goal of this project is to design long-lasting DSA to prolong its service life and reduce the costs associated with the need for frequent replacements. To achieve the goal, this study aims to: 1) design conductive and porous foamed cement paste as the encasing material for DSA, and 2) characterize the effects of different components of the paste on the life-cycle performance of newly-designed DSA and assess its effectiveness on the rehabilitation of salt-contaminated RC. Specifically, carbon fibers will be incorporated into the foamed cement paste to increase its electrical conductivity. Light weight aggregates with water or saturated calcium hydroxide (Ca(OH)2) encapsulated inside will be used in the paste to maintain a sufficient level of moisture. Electrochemical tests will be conducted to study the corrosion performance of steel bars and zinc anodes as well as evaluate the effectiveness of DSAs. Scanning electron microscopy (SEM), Energy dispersive X-ray spectroscopy (EDX), and X-ray diffraction analysis (XRD) will be employed to investigate the mechanisms related to how the foamed microstructure and different components of the paste enhance the longevity and performance of DSAs. |
| Describe Implementation of Research Outcomes (or why not implemented)  Place Any Photos Here  | Building on the success of this research, field operational tests will be conducted as part of a follow-up study. The team will work closely with local communities/agencies to install the newly designed DSAs on bridge decks and columns. Prospective users of the research product include owners and maintainers of highway bridges and urban bridges, and other stakeholders or companies (e.g., Vector Corrosion Technologies, Euclid Chemical Company, and BASF Chemical Company). The cooperation with companies listed above can improve the understanding pertinent to the functionality, cost-effectiveness, durability, and maintenance requirements of the redesigned DSA. |
| Impacts/Benefits of Implementation (actual, not anticipated)  | This work is expected to produce substantial benefits for DOTs and other concrete infrastructure owners and stakeholders. This newly-designed paste can significantly extend the service life of DSA, reduce the cost for frequent replacement of failed DSAs, and lower the workload for repair, strengthening, and rehabilitation of highway bridges and urban bridges. |
| Web links* Reports
* Project website
 | <https://tridurle.wsu.edu/design-of-long-lasting-discrete-sacrificial-anode/> |

