Thesis Project Portfolio

Finding an Empirical Relationship Between Chloride Loading Density and Conductance for the Prevention of Galvanic Corrosion in Real Environments

(Technical Report)

Investigating the Environmental Impacts of Underwater Tunneling

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Corrosion is an issue that plagues a variety of industries such as manufacturing, transportation, aerospace, and more. At the heart of the technical project is the U.S. military who is looking for ways to monitor corrosion on their assets in real time. This project involves finding an empirical relationship between chloride loading density and conductance. Simply put, this means determining how the amount of salt deposited on a metallic surface impacts conductance and, therefore, the rate of corrosion. To accomplish this, our group analyzed given laboratory data to determine variables which were important to determining the relationship between the amount of salt and conductance. These variables were plotted against one another and a logistics curve was utilized to fit the data. The function describing this curve had parameters which were able to be matched against the given variables. From this, it is possible to create a software package that is able to analyze laboratory data to find the correct chloride loading density based on a given conductance value. Additionally, this software package has the ability to analyze data collected from real environments where the chloride loading density may be unknown, simply by comparing to know laboratory values.

The applications of this project are far-reaching, from analyzing corrosion data in real time to creating finite element models to predict future corrosion rates. Material selection, material testing, and condition monitoring are all benefits of knowing how a material will perform in a real environment. The military will benefit from this project as they rely on a variety of infrastructure, equipment, and vehicles that are susceptible to corrosion, especially if these assets are located near the ocean. Having the ability to monitor the rate of corrosion on these assets gives the military the ability to better plan maintenance intervals and prevent the

degradation of equipment. Having equipment in top shape and ready to perform is something that is vital to any fighting force.

The STS section investigates the negative environmental impacts constructing underwater tunnels can have. As space becomes limited, underwater tunnels become a more enticing proposition to facilitate the movement of people and goods across bodies of water. Underwater tunnels, however, come with an array of problems that can adversely impact the environment in which they are built. The construction of underwater tunnels involves vast amounts of concrete and its constituent, cement. Cement production releases large amounts of CO2 into the atmosphere which can result in higher temperatures and the acidification of the oceans. Additionally, the dredging process used to lay underwater tunnels can result in the destruction of corals and sea life that depends on them. Finally, the noise generated during the construction phase can harm sea creatures, namely marine mammals who depend on sound for communication and finding food.

After the problem has been introduced, the paper lays out what can be done to mitigate risks to the environment. Decarbonizing cement production is a way to offset the amount of CO2 released into the atmosphere. Optimizing production, utilizing renewable fuel sources, and storing captured carbon are all methods that can be used to decarbonize the production of cement and, therefore, lower emissions. New regulations on dredging with explicit references to corals and sea life should be implemented to help reduce the levels of coral destruction. In turn, these regulations would help reduce coastal erosion and allow the corals to serve as homes for a diverse variety of sea life. Finally, noise generated during the construction of underwater tunnels can be reduced by using technologies specifically developed for this task. Underwater shielding

is one method that can be utilized to reduce noise propagation through the ocean and protect marine mammals.