Climate Effects on Modern Rail Technology

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Concerns have been expressed recently that given Hawaii's salt air environment, rust will shorten the life of major components of Honolulu's modern rail transit system. It's a valid concern for anyone who's lived in Hawaii for any significant amount of time. It's certainly been taken into consideration by those of us on the transit project team.

In brief, the impact to modern rail technology is not significant and is not a factor in determining the useful life of these components, as borne out in the experience of other coastal areas where modern rail technology has been employed.

The principle concern for any steel structure regarding corrosion is the rate at which corrosion occurs and the amount of metal loss. Studies have found that many factors contribute to the corrosion rate, including: the chemical make-up of the steel, the salinity of the environment, air pollution, rain and stray electrical current. The most important factor in modern rail design is to assure that the rail is well drained and free of collecting water that supports the chemical reaction that causes rust. Wheels remain relatively dry due to rotation, protection from the side body of the vehicle, and routine cleaning and inspection of the underside of the vehicle.

In very salty atmospheres the average corrosion rate for steel is 3.5 to 4.0 mils per year[1] (m/y) initially, then quickly drops to less than 1m/y after 2 to 3 years as the initial rust layer protects the steel by limiting the oxygen that promotes the chemical reaction. Rail has an expectant life of 30 years. With a theoretical corrosion rate of 1 m/y the impact to rail would be less than 0.03 inch. Mechanical wear of the rail is governing factor in determining rail life, and in many transit applications it is not uncommon for rails to remain in service well beyond the theoretical 30 year life. Put other way, wheels will experience mechanical wear that will require replacement before corrosion is measurable.

Another air-borne corrosive is sulfur dioxide (SO^2) that is evident in volcanic smog (vog) from the volcanic activity on the island of Hawai'i. SO^2 when mixed with rain forms acid rain that has shown to promote rust. Acid rain is also generated by coal fired generation plants that account for most of the SO^2 omissions in the continental United States. Existing modern rail systems across the U.S. have not reported corrosion concern due to acid rain. It can be concluded the same initial rust build-up that protects the rail from excessive rust growth applies to acid rain.

Actual experience in the industry confirms that corrosion effect from the atmosphere is not been a concern for rail that is well drained and free of pockets that can collect water and pollutants. Personal experience of 40 years of engineering and maintaining both

[1] Mil is equal to 1/1000 of an inch

freight and transit rail systems, I have never replaced rail due atmospheric corrosion. This includes 13 years as Chief Engineer at BART, located in San Francisco Bay Area, and over 20 years with the Union Pacific Railroad, with lines throughout the western United States. Another example of rails surviving can be found here in Honolulu with the Oahu Railway and Land Company (OR&L) Rails from the old sugar cane railroad can be found today in operation for rail excursions on the Leeward side of the island, well beyond the 30 year theoretical life.

Electrified railways do present a challenge from stray current leaving the rail section inducing a metal loss, similar to corrosion. This phenomenon is well understood and in today's modern systems fastener designs successfully mitigate this condition. Electrified third rail are normally fabricated from aluminum and do not rust. Train control and communication systems are housed within climate controlled rooms, and most wayside cabling is fiber optic or copper that do not rust.

In closing, a modern rail transit system will provide a long service life of 30 plus years, as proven in systems all over the world in climates similar to Hawai'i. The salt air conditions will be considered in the design of all elements of the system, including those elements that are common to any technology; such as reinforced concrete guideway structures, stations furnishings, and appliances.