The Correlation between Avian Feces and Corrosion

The U.S. Army Corps of Engineers identified bird feces as their highest concern when assessing avian impact on their civil works projects [1]. While Krzysik noted that there are health hazards associated with avian feces and that it reduces the aesthetics, from an engineering perspective it adversely impacts maintenance procedures and schedules and causes deterioration of mechanical, electrical, and hydraulic equipment.

Kulicki et al. [2] note in their report that avian feces contain acids that damage steel members and protective coatings [2], failure of the latter triggers corrosion of the substrate.

Price and Figueira note that offshore structures are under attack from long term exposure to humidity with high salinity, intensive influence of UV light, wave action, and avian feces [3] making such an environment one of the most corrosive.

Coating failure leads the ingress of moisture and oxidation agents to accelerate corrosion of the substrate. Substrate corrosion leads to more severe and widespread coating failure. Once a coating fails it starts a cycle that degrades over time [4].

Birds expel solid waste from the intestines mixed with concentrated uric acid $C_5H_4N_4O_3$ from the kidneys. The pH of natural bird droppings is relatively high: ~3.0 - 4.5 [5]. Hydrogen (H+) ions found in the uric acid of bird droppings will penetrate any coating sealants and start etching the coating itself. Uric acid also contains protease, a highly acidic enzyme with a pH ≈ 2 which catalyzes chemical reactions.

Alsoufi and Bawazeer [5] conducted an experiment to quantify the change in surface roughness in automotive coatings when exposed to avian feces for only 24 hours. Indoor testing was conducted in a laboratory atmosphere with an ambient temperature of 20±1°C and a relative humidity of greater than 40±5%. Outdoor testing exposed the samples to the local temperature and humidity and solar UV radiation. The surface profile was measured to quantify the average roughness; the results are shown in Figure 1.

After 24 hours of exposure to bird feces, those specimens tested in the laboratory experienced a 9.8% increase in average surface roughness, and those tested outdoors experienced a 15.0% increase in average surface roughness.

Alsoufi and Bawazeer [5] concluded that environmental and biological attacks roughened the surface. Furthermore, it is evident that this becomes more severe when both environmental and biological conditions are introduced simultaneously.

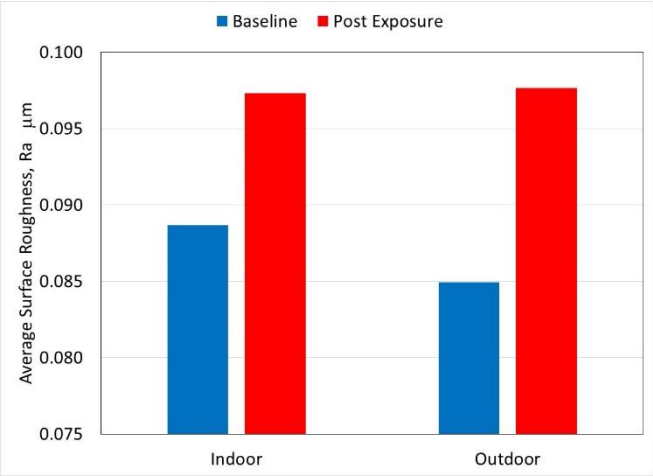

Figure 1. Effect of natural bird droppings on a painted automotive body surface after 24 hours

References

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