Aluminium Alloy Fuel Tank Failure - Evidence from Corrosive Aerobic Hydrocarbon-Degrading Microorganisms and Anaerobic Sulfate-Reducing Bacteria

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Abstract This study assessed the phenomenon of microbial deteriorated corrosion in aircraft fuel tanks with seal failure, discovering the mechanism of sealant-aluminium alloy deterioration caused by fuel microbial contamination. Aerobic microorganisms such as *Pseudomonas aeruginosa* accelerate pitting corrosion of 2024T3 aluminium alloy, which was related to formation of micro-galvanic couples. The abiotic deposition of C and P elements maybe mainly affect formation of corrosion products on surface of aluminium alloy and coating components. Hydrocarbon-degrading *Shewanella algae* accelerated corrosion of LY12 aluminium, but inhibited corrosion of 7B04 aluminium through nitrate reduction. Coating on 7B04 aluminium alloy can reduce biofilm coverage, but it still cannot avoid the deterioration effects induced by S. algae, such as pitting, swelling, and peeling. 7B04 aluminium alloy has better corrosion resistance in the fuel-water system than LY12. The combination of zinc-yellow acrylic polyurethane primer and TS96-71 fluorocarbon polyurethane finish provides better corrosion protection [1]. Anaerobic microorganisms like *Pseudodesulfovibrio indicus* disrupted the passivation film of aluminium by forming sulfides, and the mixed biological contamination led to deterioration of fuel quality. In the co-cultivation system of *Desulfovibrio bizertensis* (SRB) and *Methanosarcine barkeri* (MPA), which exhibited the most severe corrosiveness, the potential microbial extracellular electron transfer mechanism accelerated the dissolution of aluminium alloy. There was no coupling relationship between the interspecies promotion of SRB in corrosion effects and the interspecies inhibition of fuel degradation by MPA. The degree of degradation of the sealant by SRB and MPA decreased over time, which was related to the fuel co-metabolism activity of microorganisms attached to the sealant surface. In the qualitative and quantitative models describing the corrosion of aluminium alloy and the degradation of sealant in fuel-water systems, we identified the galvanic

electrochemical effect and the redox activity of fuel as two important parameters that might characterize the mechanism of seal failure in fuel tanks.

Keywords Fuel contamination; Microbiologically influenced corrosion; Sulfate-reducing bacteria; *Shewanella algae*; Sealant-aluminium; Extracellular electron transfer

Reference

[1] D. Guo, Y. Zhang, Y. Li, B. Lu, H. Huang, X. Li, J. Duan, Hydrocarbon-degrading *Shewanella algae* shows oxidative deteriorated corrosion at the aluminium alloy & coating interface, Corros. Sci. 234 (2024) 112072, https://doi.org/10.1016/j.corsci.2024.112072.