

Mitigating the Mississippi River Saltwater Wedge Crisis

Executive Summary

The ongoing "saltwater wedge" migration up the Mississippi River has fundamentally altered the electrochemical environment of the New Orleans District's hydraulic infrastructure, specifically threatening the structural integrity of miter gates. As saline seawater introduces high sulfate concentrations into nutrient-rich freshwater, it triggers an aggressive surge in Sulfate-Reducing Bacteria (SRB) and metal-reducing species like *Shewanella oneidensis*, creating a high-velocity Microbiologically Influenced Corrosion (MIC) circuit that standard coatings cannot terminate. Royal Coatings provides the definitive solution with **Flex 200-GFCU**, a patent-pending, 100% solids antimicrobial epoxy system that has demonstrated a 7-day total kill of these specific threat organisms. Unlike traditional barriers, this system is fully applicable and curable under immersed conditions, allowing for critical gate remediation without the massive operational downtime of cofferdams. By maintaining a non-ablative antimicrobial leach rate of $0.313 \mu\text{g}\cdot\text{cm}^2 \text{d}^{-1}$, Flex 200-GFCU delivers sustained biostatic protection that stabilizes the metal-liquid interface, effectively halting the biogenic pitting that currently jeopardizes the District's navigation and flood protection assets.

Royal Coatings has developed a proprietary **100% solids epoxy-based coating system** with integrated antimicrobial functionality, specifically engineered to mitigate **Microbiologically Influenced Corrosion (MIC)** in demanding industrial environments. The system has demonstrated robust antimicrobial efficacy against key MIC-associated bacterial classes—including sulfate-reducing, acid-producing, and slime-forming—through multiple independent third-party laboratory validations.

The coating system is:

- Fully applicable and curable under immersed (underwater/submerged) conditions
- Patent-pending (U.S. Patent Application No. 18/626,558)
- EPA-registered as an antimicrobial pesticide 10/3/2024
- Characterized by a very low non-ablative leach rate of $0.313 \mu\text{g}\cdot\text{cm}^{-2}\cdot\text{d}^{-1}$ (ISO 10890)

Durability testing to **NORSOK M-501** standards shows excellent adhesion retention after cyclic aging and long-term seawater immersion (pull-off values ≥ 11.35 MPa post-exposure). Microbiological testing confirms strong to complete inhibition of target organisms relevant to oil & gas, water/wastewater, power generation, and marine applications.



Key Technical Specifications

- Application and full cure possible under fully immersed (underwater) conditions.
- Patent Pending: U.S. Application No. 18/626,558.
- EPA Registration: 10/3/2024
- Non-ablative antimicrobial leach rate (ISO 10890): **0.313 $\mu\text{g}\cdot\text{cm}^{-2}\cdot\text{d}^{-1}$** .

Third-Party Performance & Durability Testing

Testing Laboratory: KTA-Tator, Project No. 410646-A1 **Standard:** NORSOK M-501

Test Description	Standard	Duration/Condition	Pull-Off Adhesion
			Result
Initial Adhesion	ISO 4624:2016	As-applied	11.91 MPa
Cyclic Aging (accelerated weathering)	ISO 20340:2009	4,200 hours	11.35 MPa
Continuous Seawater Immersion	ISO 2812-2:2007	4,200 hours	18.52 MPa

Third-Party Microbiological Efficacy Testing

Louisiana State University (Chen Lab)

- Method: CLSI M07
- Organism: *Staphylococcus aureus* (slime-forming bacteria)
- Result: Significant growth inhibition

Element Materials Technology – Report No. N1001

- Method: Modified ASTM G22
- Organism: *Desulfovibrio piger* ATCC 29098 (sulfate-reducing, anaerobic)
- Result: Complete growth inhibition; **7.64 mm** zone of inhibition

GTI Energy – Report No. 242749 (Bacteria harvested from failed oil pipeline isolates)

- Method: ASTM E2647-20 (qPCR-based)
- Organisms: *Clostridium* spp. and *Acetobacterium* spp. (acid-producing, anaerobic; pipeline failure isolates)
- Result: **93.75%** reduction in maximum bacterial population

Element Materials Technology - 7 Day total kill

- Method: JIS Z 2801 (surface antimicrobial activity)
- Organisms (multi-class):
 - *Pseudomonas fluorescens* (aerobic, biofilm-forming)
 - *Acetobacter aceti* (acid-producing)
 - *Shewanella oneidensis* (metal-reducing)